



Comparative Dwell and Journey Time Surveys

Final - Report
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Steer Davies Gleave

Our ref: 22780601
Client ref:

Prepared by:

Steer Davies Gleave
28-32 Upper Ground
London SE1 9PD

+44 20 7910 5000
www.steerdaviesgleave.com

Prepared for:

Steer Davies Gleave
Transport for London

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Executive Summary

Steer Davies Gleave has undertaken a dwell time and journey time survey on behalf of Transport for London on two pairs of London Bus routes: 53 & 453 and 24 & 29. The survey follows two previous studies undertaken in 2003 and 2008 on the 53 & 453. The results of the previous surveys serve as a comparison in this report.

The principal objectives of the new 2015 study is to assess the impact on dwell times of:

- the introduction of cash free buses in July 2014;
- the introduction of three-door New Routemaster buses which allow passengers to board and alight from the front, middle or rear door; and
- the different operating characteristics of the New Routemaster buses where an additional member of staff is positioned at the rear door to check for tickets and allow passengers to hop on and hop off between stops.

Key Findings, Dwell Time:

The key findings comparing the routes are detailed below:

- On comparable routes (24 vs 29 and 453 vs 53)
 - The New Routemaster buses were found to have faster marginal boarding/alighting times than the traditional double-deckers;
 - The New Routemaster buses were found to have higher fixed stop constants than the traditional double-deckers;
- The New Routemaster buses had higher average dwell times than the traditional double-deckers;
- 5% of boarders were found to board between stops on Route 24 (New Routemaster); and
- The proportion of boarders not presenting fare is higher on Route 453 (New Routemaster, one person operated) than on other routes. 4% compared to less than 1%.

Key Findings, Journey Time:

The key findings comparing routes 53 & 453 are detailed below:

- Average journey times towards Whitehall are highest in the AM Peak on both routes;
- The 53's journey times are lower than route 453 towards Whitehall across all time periods but particularly the PM peak;
- Average journey times going towards Deptford are highest in the PM peak on both routes;
- Journey times are lower on route 453 at all times except during the PM peak where they are marginally lower on the 53 in this direction; and
- In comparison with 2008, average journeys times towards Deptford have increase by 16% or 6.1 minutes. Average journeys times towards Whitehall have only slightly increased.

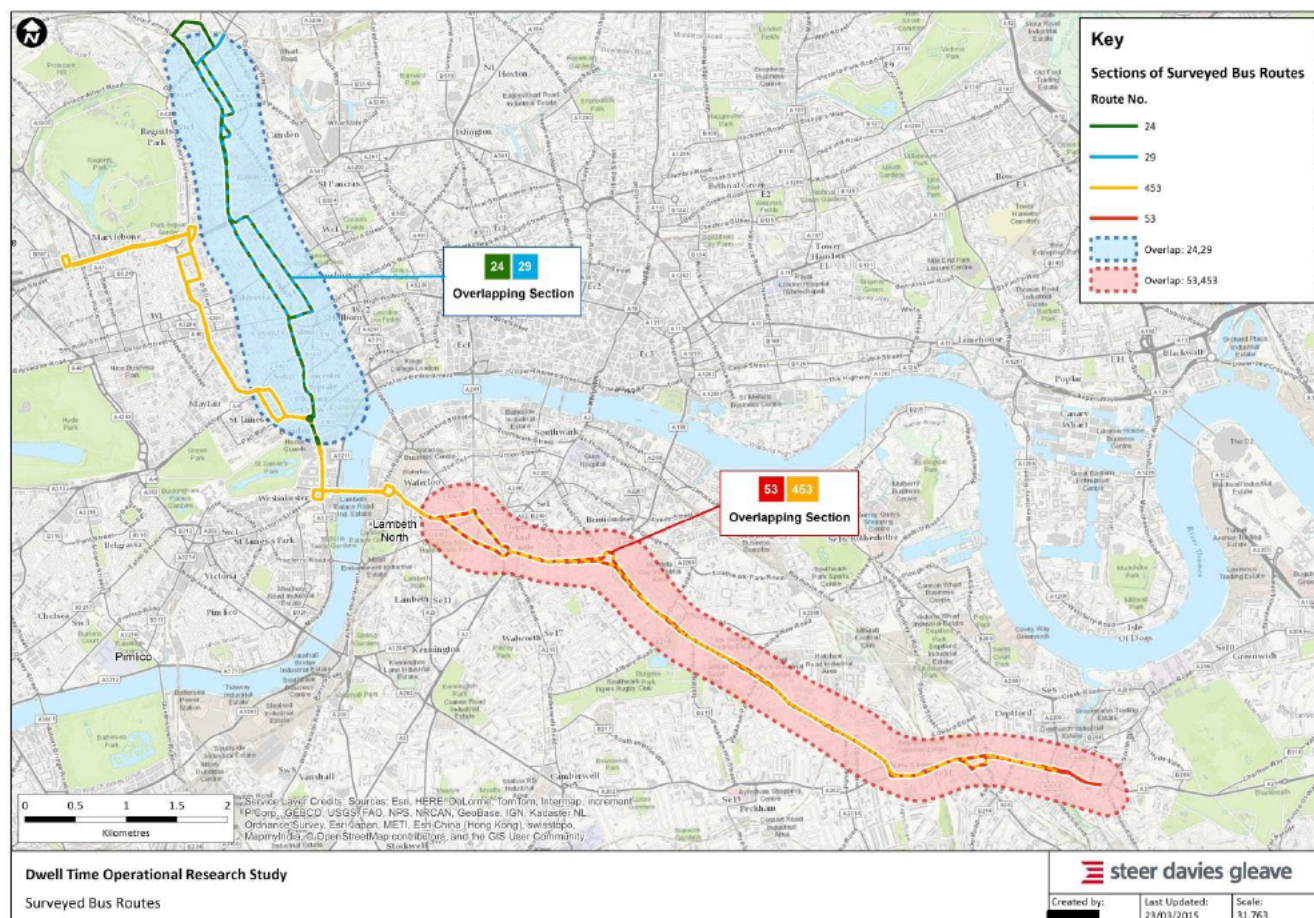
The key findings comparing routes 24 & 29 are detailed below:

- Average journey times on the overlapping section are marginally longer on both the northbound and southbound trips on the 24;
- Average journey times are highest in the interpeak on both routes;
- In both directions, journey times are lower on route 29 across all time periods;
- Route 24 has two discrete sections – one in the north (Hampstead to Camden) and one in the south (Pimlico to Trafalgar).
 - On the northern section, journey times are marginally longer towards Camden than Hampstead whilst on the southern section, journey times are marginally longer towards Trafalgar than Pimlico.
- Average journey times have increased by 17% toward Camden and 10% toward Whitehall since the 2008 survey.

1 Introduction

- 1.1 Steer Davies Gleave has undertaken a dwell time and journey time survey on behalf of Transport for London on two pairs of London Bus routes: 53 & 453 and 24 & 29. The survey follows two previous studies undertaken in 2003 and 2008 on the 53 & 453. The results of the previous surveys serve as a comparison in this report.
- 1.2 The objective of the new 2015 study is to measure any differences in boarding and alighting and journey times between the two pairs of bus routes. This is in light of the introduction of cash free buses in 2014, the introduction of New Routemaster buses on the 453 and 24 and the different operating conditions on the New Routemasters.
- 1.3 In order to compare the New Routemasters to the traditional double deckers, the route pair's overlapping sections were surveyed. The overlapping section is shorter than in the previous surveys following to the curtailment of route 53 due to major road works in the area. The extent of the survey is shown in Figure 1.1 below.

Figure 1.1 Map of Surveyed Routes



- 1.4 The overlapping section of routes 53 and 453 between Lambeth North and Deptford Bridge was surveyed. The section along route 453 between Marylebone and Whitehall was also surveyed. The section of route 53 between Deptford and Plumstead was not surveyed in 2003 nor 2008 and thus has not been surveyed on this occasion either. The overlapping section is shorter than in the previous surveys as major roadwork required that the 53 terminate early.
- 1.5 Only the overlapping section of routes 24 and 29 between Trafalgar Square and Camden Town was surveyed.
- 1.6 The bus type and operation conditions of the different routes are shown in Table 1.1.

Table 1.1: Bus Type and Operating Condition of Surveyed Routes

Route	Shorthand	Bus type	Operating condition	Description of operation
53	DD	Traditional Double Decker	One person operated	Driver checks fares at front door. Passengers are required to board at the front door and alight via the rear doors. All doors are closed while the bus is in operation.
453	NR, OPO	New Routemaster	One Person Operated	Driver checks fares at front door. Passengers can board or alight via the front, middle or rear doors. All doors are closed while the bus is in operation.
24	NR, CO	New Routemaster	Crew Operated	Driver checks fares at front door and crew member checks fares at rear door. Passengers can board or alight via the front, middle or rear doors. The rear door remains open at all times to allow passengers to hop on and off when the bus is stationary between stops. This route was only surveyed whilst it was in crew mode (operated between 06:00 – 19:00).
29	DD	Traditional Double Decker	One Person Operated	Driver checks fares at front door. Passengers are required to board at the front door and alight via the rear doors. All doors are closed while the bus is in operation.

2 Dwell Time Methodology

Introduction

- 2.1 This chapter describes the approach to the fieldwork that was undertaken for the dwell time survey.
- 2.2 Surveyors were given Android smartphone devices with which to collect data whilst travelling on the buses. The devices were fitted with survey software developed by Steer Davies Gleave. These devices provided a user friendly interface for data collection, ensured that timing was accurate and consistent and also provided a convenient data output format.
- 2.3 The change to Android smartphone devices from the originally proposed iPAQ devices was necessary because the software for the iPAQ devices was no longer supported by Microsoft. The survey was designed to be consistent with the previous surveys.

Survey Design

- 2.4 The principal objectives of this research were to assess the impact on dwell times of:
- the introduction of cash free buses in July 2014;
 - the introduction of three-door New Routemaster buses which allow passengers to board and alight from the front, middle or rear door; and
 - the different operating characteristics of the New Routemaster buses where an additional member of staff is positioned at the rear door to check for tickets and allow passengers to hop on and hop off between stops.
- 2.5 Dwell times are a function of events occurring at each stop such as: boarding and alighting passengers, their method of payment and specific incidents that occur during stops. Therefore, it is important that the survey efficiently captures all this information at each stop, allowing for comparison between the different bus routes.
- 2.6 The information collected at each stop along all routes was:
- Route number;
 - Direction;
 - Bus registration number;
 - Stop name;
 - Wheels stop and move times;
 - Doors open and close times;
 - Number of passengers boarding (by payment method) and alighting; and
 - Any unusual events which may have affected the dwell time.
- 2.7 Screenshots of all of the data entry screens and the briefing note given to surveyors are provided in Appendix A and B.

- 2.8 The traditional double-decker buses have two doors, the New Routemaster buses have three. One surveyor was assigned to collect data at each door. In the data analysis stage, the door records for a particular stop were combined to form a single dwell record.

Fieldwork

- 2.9 Dwell time fieldwork took place on 15 weekdays over a period of three weeks, and was scheduled to avoid the atypical period of school summer holidays. Routes were surveyed between 21st January and 11th February. No surveying was conducted on 5th February due to bus strikes. Seven days of data was collected for each route, except for route 29, which had an additional half day.
- 2.10 Surveying took place from 7am to 7pm to cover morning peak (07:00-10:00), inter peak (10:00-16:00) and afternoon peak (16:00-19:00) periods.
- 2.11 Surveyors travelling on the buses were instructed to position themselves at locations on board that provided a good vantage point to record and assess passenger activity. Table 2.1 shows the sections of each route over which stop event information was recorded.

Table 2.1 Section of Routes Surveyed

Route	Start / Finish	Finish / Start
53, DD	Lambeth North	Deptford Bridge, New Cross
453, NR-OPO	Great Central Street, Marylebone	Deptford Bridge, New Cross
24, NR-CO	Trafalgar Square	Camden Town
29, DD	Trafalgar Square	Camden Town

3 Journey Time Methodology

Introduction

3.1 This chapter explains how journey times were measured and when the fieldwork took place.

Survey Design

3.2 The objective of this survey was to compare average journey times between the pairs of routes and to compare them with the previous journey time study undertaken for routes 53 and 453 by SDG in 2003 and 2008. Details of the surveyed sections of the pairs of routes are outlined in Figure 3.1, Table 3.1 and Table 3.2. The capital letter identifies the TfL stop letter assigned to the surveyed stops.

Figure 3.1 Journey Time Survey Locations

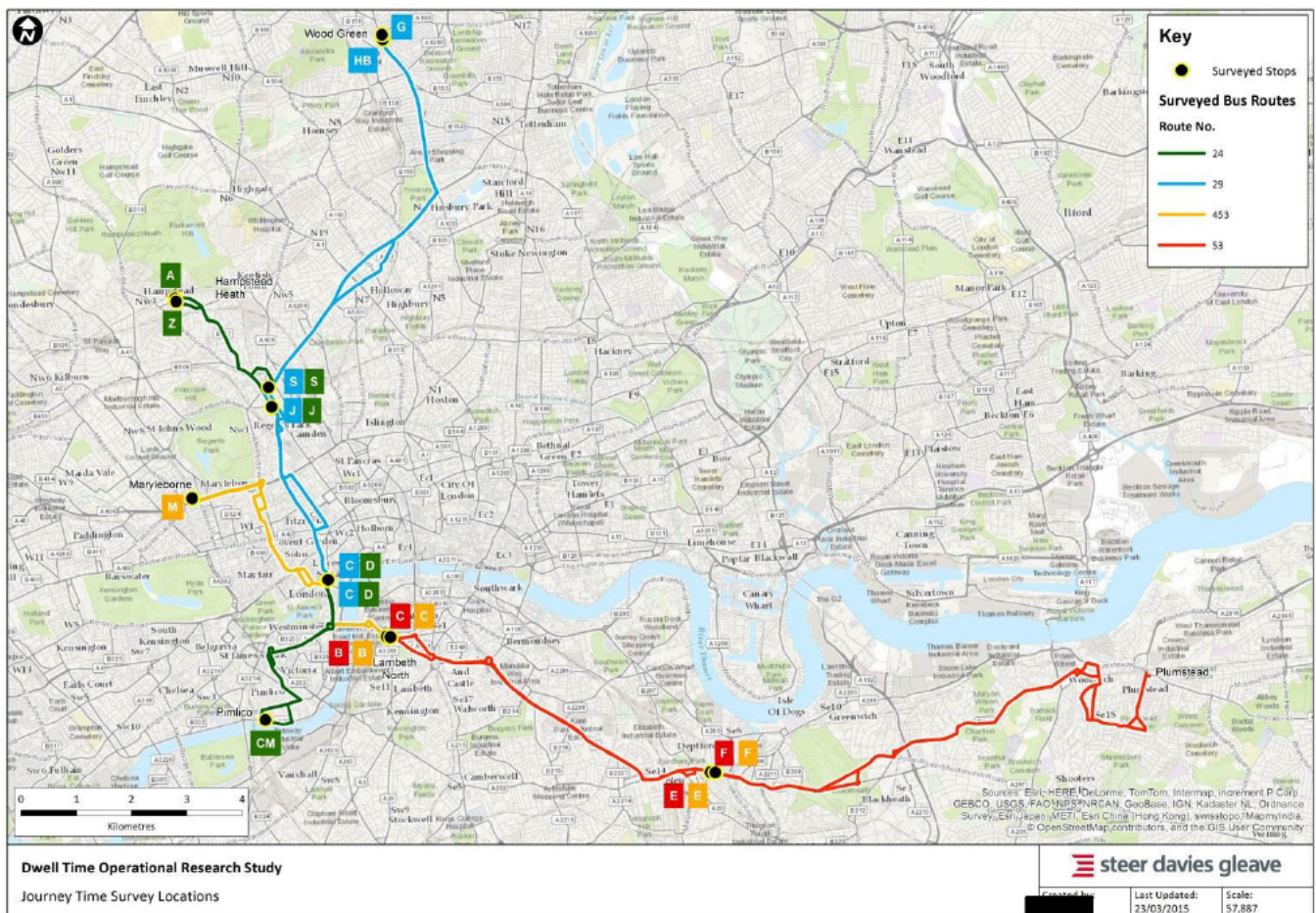


Table 3.1 Overlapping Section for Journey Time Survey

Route	Survey between
54 & 453	Lambeth North (<u>Stops B & C</u>) – Deptford Bridge (<u>Stops E & F</u>)
453	Lambeth North (<u>Stops B & C</u>) – Marylebone (<u>Stop M</u>)

Table 3.2 Overlapping Section for Journey Time Survey

Route	Survey between
24	Pimlico (<u>Stop CM</u>) – Trafalgar Square (<u>Stops C & D</u>)
24 & 29	Trafalgar Square (<u>Stops C & D</u>) – Camden Town (<u>Stops J & S</u>)
24	Camden Town (<u>Stops J & S</u>) – Hampstead Heath (<u>Stops Z & A</u>)
29	Camden Town (<u>Stops J & S</u>) – Wood Green (<u>Stops HB & G</u>)

- 3.3 Surveyors were assigned to various stops along the routes to record the wheel stop times of the buses. Wheel start was recorded if the bus was leaving the first stop. They were given paper booklets containing data collection forms on which to record journey time data. Examples of the briefing note given to surveyors and the forms they were provided with are shown in Appendix C and D.
- 3.4 Records were matched together by registration number. Links to the TfL website showing the location of each designated stop are provided in the tables in Appendix C. All times were recorded to the nearest second using handheld clocks, synchronized daily at the start of the shift.

Fieldwork

- 3.5 Surveying was carried out on the following days, with the intention of covering a variety of weekday conditions:
- Wednesday 28th January 2015
 - Thursday 29th January 2015
 - Wednesday 4th February 2015
- 3.6 Surveying took place from 7am to 7pm on each day, covered by two shifts of surveyors at each of the stops. Unusually severe congestion was experienced for part of the day on 29th January 2015 on the overlapping section of the 53 & 453. This caused journey times to be extended as buses were delayed and many were short-turned. These journeys were identified as outliers and removed from journey time analysis as described in section 6.

4 Dwell Time Sample Survey

Introduction

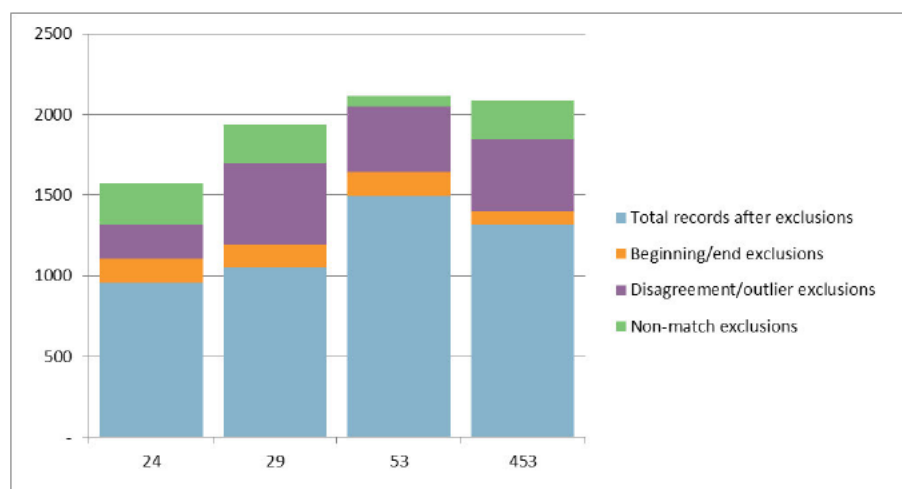
4.1 After retrieving the data collected from the handheld devices, the stop event data for all doors on the same bus were matched to create a single composite record for each stop by route and direction. After this, the data was cleaned of records deemed to be inaccurate or anomalous. Records were removed for the following reasons:

- Records that could not be matched due to inconsistent data entry between surveyors
- Records with significant differences in dwell time between surveyors on the same bus
- Records identified as outliers
- Stops at the start and end of each run

4.2 The total number of records excluded from the stop event data for each route can be seen in Table 4.1 and this is shown graphically in Figure 4.1.

Table 4.1 Sample Size and Exclusions

	53, DD	453, NR-OPO	24, NR-CO	29, DD	Total
Total Records Collected					
- Overlapping Section	2110	1188	1562	1928	6788
- Other	0	891	0	0	891
- Total	2110	2079	1562	1928	7679
Total Records after Exclusions					
- Overlapping Section	1492	825	957	1049	4323
- Other	0	493	0	0	493
- Total	1492	1318	957	1049	4816
% of Records Excluded					
- Overlapping Section	29%	31%	39%	46%	36%
- Other		45%			45%
- Total	29%	37%	39%	46%	37%

Figure 4.1: Sample Size and Exclusions

4.3 There is a greater percentage of records excluded on route 29 compared to the 24 due to a larger number of disagreements (not meeting the dwell time agreement threshold) in dwell times between surveyors. A greater number of records is retained than in the previous study and the number of records maintained on the common sections of all routes is sufficient to perform the analysis.

4.4 Table 4.2 describes the cleaned dataset by time of day.

Table 4.2 Stop Event Data by Time of Day

	53, DD	453, NR-OPO	24, NR-CO	29, DD
Before 10:00	30%	33%	29%	30%
10:00 to 16:00	44%	44%	48%	48%
After 16:00	26%	23%	23%	22%

4.5 The number of observations split by time of day is consistent between comparable routes. The data is therefore consistent for the purposes of analysis. There is a greater proportion of observations in the inter peak period because there are more inter peak hours.

Boarding and Alighting Profiles

4.6 Passengers boarding the bus were classified by their payment type. Table 4.3 illustrates the number and percentage of boarders by payment method, as well as total alighters for all routes.

Table 4.3 Boarders by Type and Total Alighters

	53, DD	%	453, NR-OPO	%	24, NR-CO	%	29, DD	%
Total Boarders	4,121		3,865		2,426		2,207	
-Smart Card Payment	4,023	98%	3,624	94%	2,260	93%	2,095	95%
-Smart Card Rejected	8	0%	26	1%	20	1%	15	1%
-Pass Shown	55	1%	45	1%	100	4%	67	3%
-No Fare Presented	16	0%	157	4%	29	1%	21	1%
-One More Journey Warning	19	0%	13	0%	17	1%	9	0%
Total Alighters	4,496		3,720		2,830		2,820	

- 4.7 Table 4.3 shows the total number of boarders and alighters captures in this study. The difference between the total boarders and total alighters is due to the surveys beginning and ending mid-route and to the data cleaning process.
- 4.8 Table 4.3 also shows the percentage breakdown of boarders by payment type. The proportion of boarders not presenting fare on route 453 was 4%, higher than on the other routes. This was evenly distributed between the middle and rear doors. The 29 and 53 are OPO double-decker buses which require passengers to board through the front door. The 24 is a crew-operated New Routemaster, meaning that the rear door is monitored and the proportion of passengers not presenting fare is highest at the middle door. The 453 is OPO, meaning passengers are able to board through any door, but fares are only monitored at the front door. Passengers with valid fare (weekly or monthly prepaid Oyster pass) are not required to tap in when boarding and thus the increase in boarders not presenting fare on the 453 would be a mix of passengers with and without valid fare.
- 4.9 As cash payments are no longer accepted on London Buses, no boarders paid cash. However, the proportion of boarders using cash payments in 2008 was already very small with less than 1% of people paying with cash.

Boarding between stops

- 4.10 The New Routemaster buses have a rear door. The 453 is one person operated, the rear doors are only opened when at a stop. The 24 is crew operated, meaning that the rear door is monitored, allowing 'hop-on/hop-off'. Table 4.4 shows the number of passengers boarding between stops.

Table 4.4 Number of Passengers Boarding Between Stops

	53, DD	453, NR-OPO	24, NR-CO	29, DD
Board Between Stops	0	13	116	0
- as a % of boarders	0%	0%	5%	0%

- 4.11 5% of passengers on Route 24 use the hop-on hop-off service. The small number of passengers boarding between stops on the 453 suggests that some drivers do allow boarding between stops even under OPO.

Wheelchair and Pram Activities

- 4.12 Table 4.5 shows the number of wheelchair and pram activities on each route. Passenger activity refers to either a boarding or alighting passenger.

Table 4.5 Wheelchair and Pram Activities

	53, DD	453, NR-OPO	24, NR-CO	29, DD	Total
Wheelchair Activity	1	5	4	3	13
- as a % of total activities	0.0%	0.1%	0.1%	0.1%	0.0%
Pram Activity	79	77	35	27	218
- as a % of total activities	0.9%	1.0%	0.7%	0.5%	0.8%

- 4.13 The percentage of pram activities is higher on the 53/453 route pair than on the 24/29 route pair. The number is very similar for each route pair, both route 453 and 53 have about 1% of activities as pram activities.

Unusual stop events

4.14 Unusual stop events were recorded for each route as shown in Table 4.6.

Table 4.6: Unusual Events by Route

	453, NR-OPO	% of stop events	24, NR-CO	% of stop events	29, DD	% of stop events	Total (excluding 53)	% of total stop events (excluding 53)
Late boarder	19	1%	44	5%	27	3%	92	3%
Slow Boarder	46	3%	43	4%	46	4%	135	4%
Footway crowded	8	1%	2	0%	4	0%	14	0%
Crowded bus	35	3%	0	0%	11	1%	46	1%
Obstruction	9	1%	8	1%	9	1%	26	1%
Vehicle in the way	2	0%	20	2%	8	1%	30	1%
Sent from rear to front	1	0%	1	0%	0	0%	2	0%
Total	120	9%	118	12%	105	10%	345	10%

4.15 Table 4.6 shows that late and slow boards affect approximately 7% of dwells in this study. All other unusual events affect roughly 3% of the total dwell events recorded. Due to an error in data collecting, unusual event data for route 53 was not considered accurate and was not included in this analysis.

5 Dwell Time Results and Analysis

Average Dwell Time and Boarding/Alighting Activity

- 5.1 Using the clean dataset, the average dwell times and passengers activities were calculated over the *overlapping* route sections. These statistics are shown in Table 5.1.

Table 5.1 Dwell Times

	53, DD	453, NR-OPO	24, NR-CO	29, DD
Average Boarders	2.8	3.5	2.5	2.1
Average Alighters	3.0	3.1	3.0	2.7
Average Passenger Activity	5.8	6.6	5.5	4.8
Average Dwell Time (sec)	20.8	21.7	20.3	16.7
Average Time per Activity	3.6	3.3	3.7	3.5
Minimum Stop Time (sec)	2.5	2.5	3.5	3.5
Maximum Stop Time (sec)	69.0	65.5	70.0	70.0
Number of Dwells	1492	825	957	1049

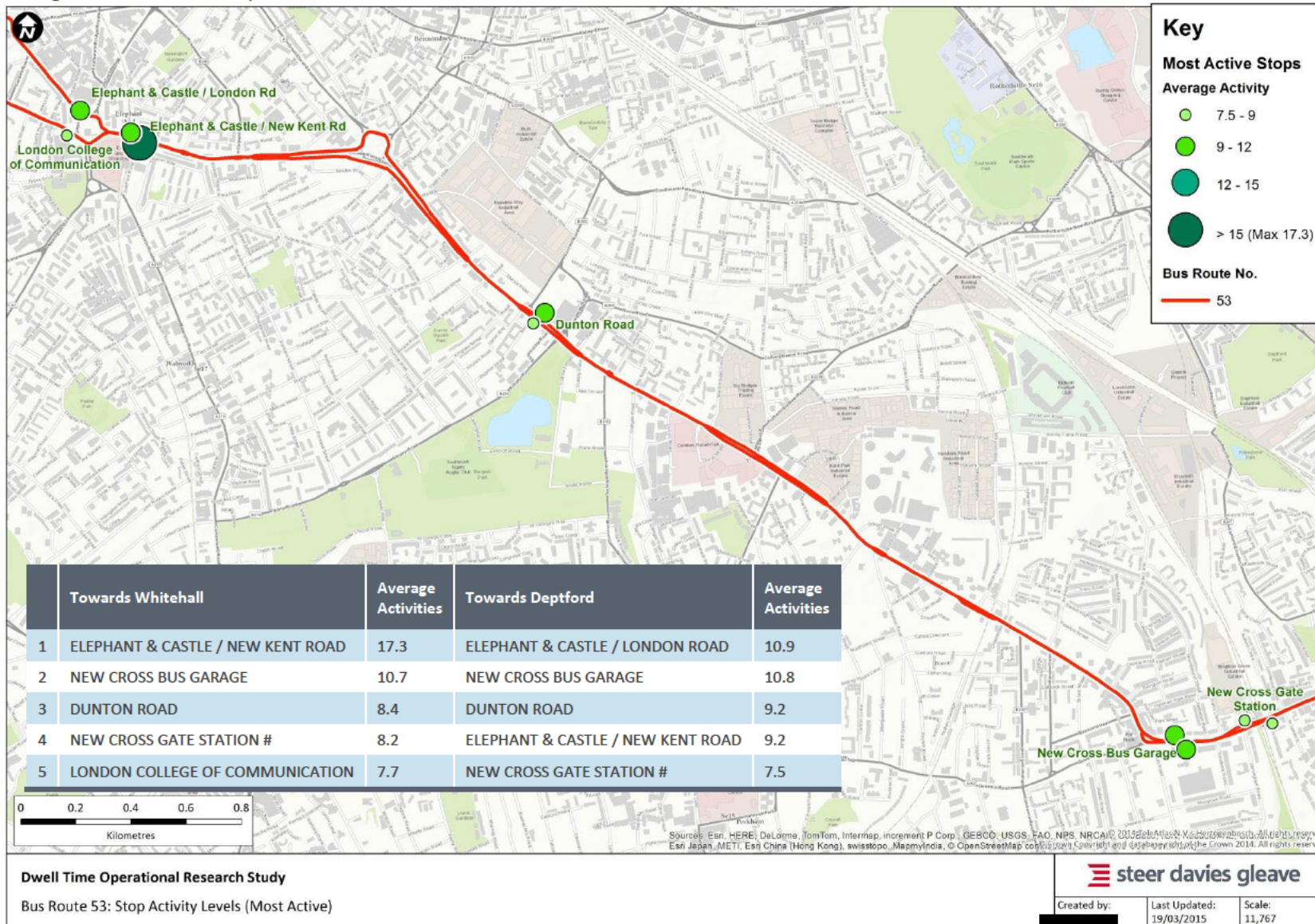
- 5.2 Route 453 has 0.8 more passenger activities per stop on average than route 53. The average dwell time per activity is slightly lower on the 453 (New Routemaster), by 0.3 seconds. The average dwell time for Route 453 is 0.9 seconds greater than Route 53 on average.
- 5.3 Route 24 has 0.7 more passenger activities per stop on average than route 29. The average dwell time per activity is also slightly higher on the 24 (New Routemaster), by 0.2 seconds. The average dwell time for Route 24 is 3.6 seconds greater than on Route 29.
- 5.4 In both instances the New Routemaster buses have longer average dwell times than the double-decker buses. See the Marginal Activity Time Analysis section for further explanation of these results.

Stop to Stop Analysis

Stop Activity Levels

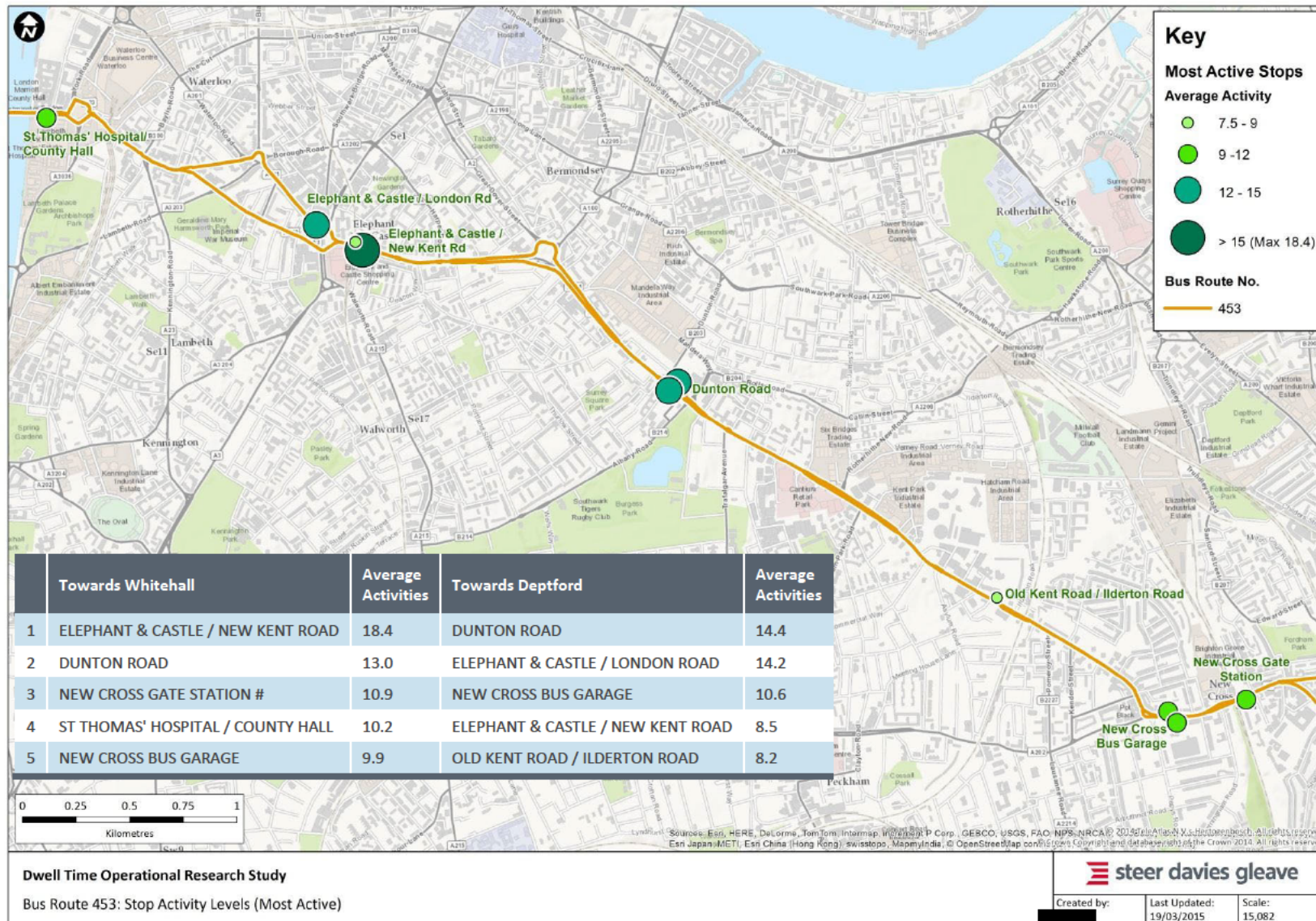
- 5.5 Figure 5.1 to Figure 5.4 show the most active stops for each route.

Figure 5.1: Most active stops, route 53



U:\London\Projects\227\8\00\01\GIS\MAPPING\Area maps\documents\Route 53 Stop Activity.mxd

Figure 5.2: Most active stops, route 453



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Figure 5.3: Most active stops, route 24

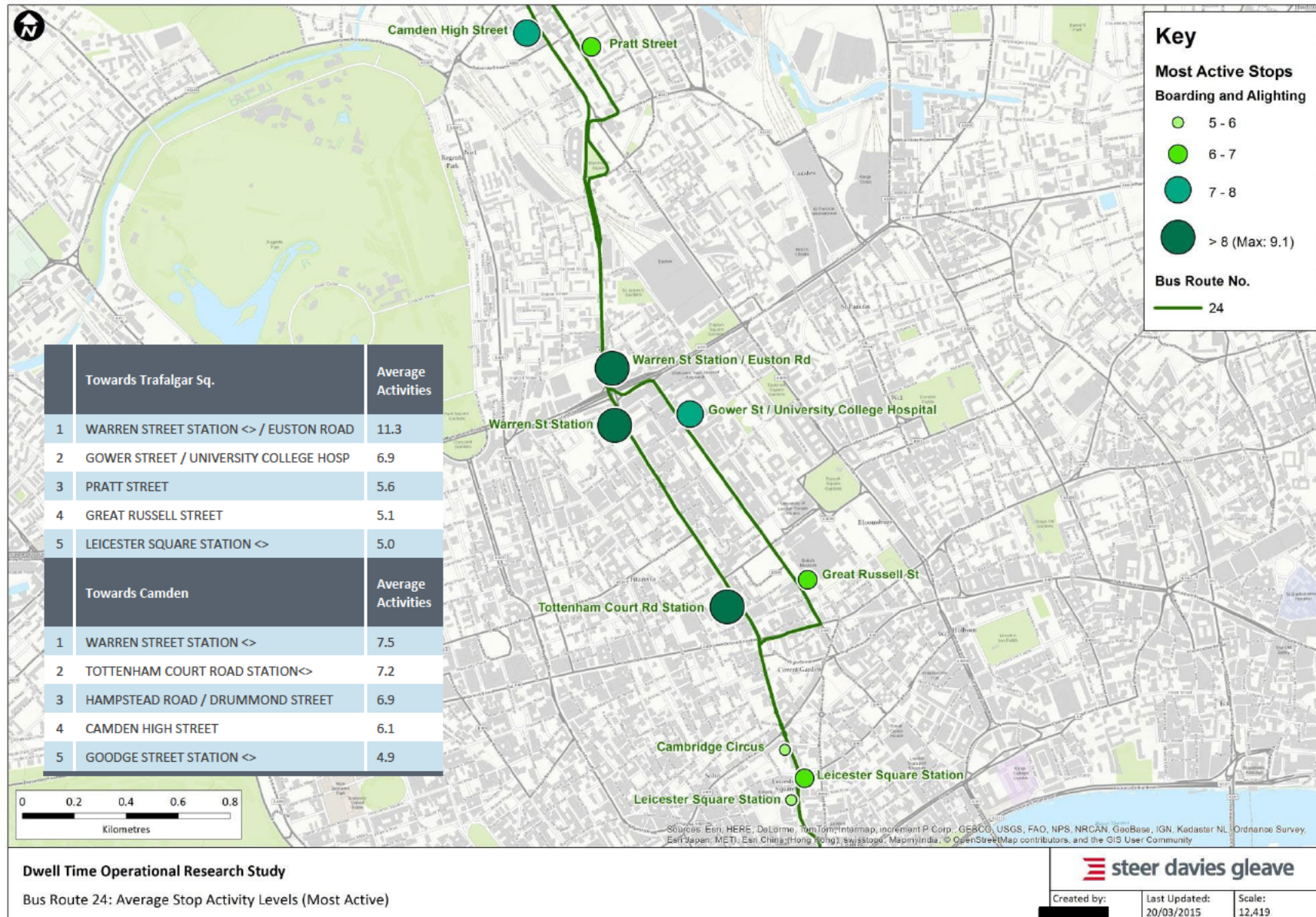
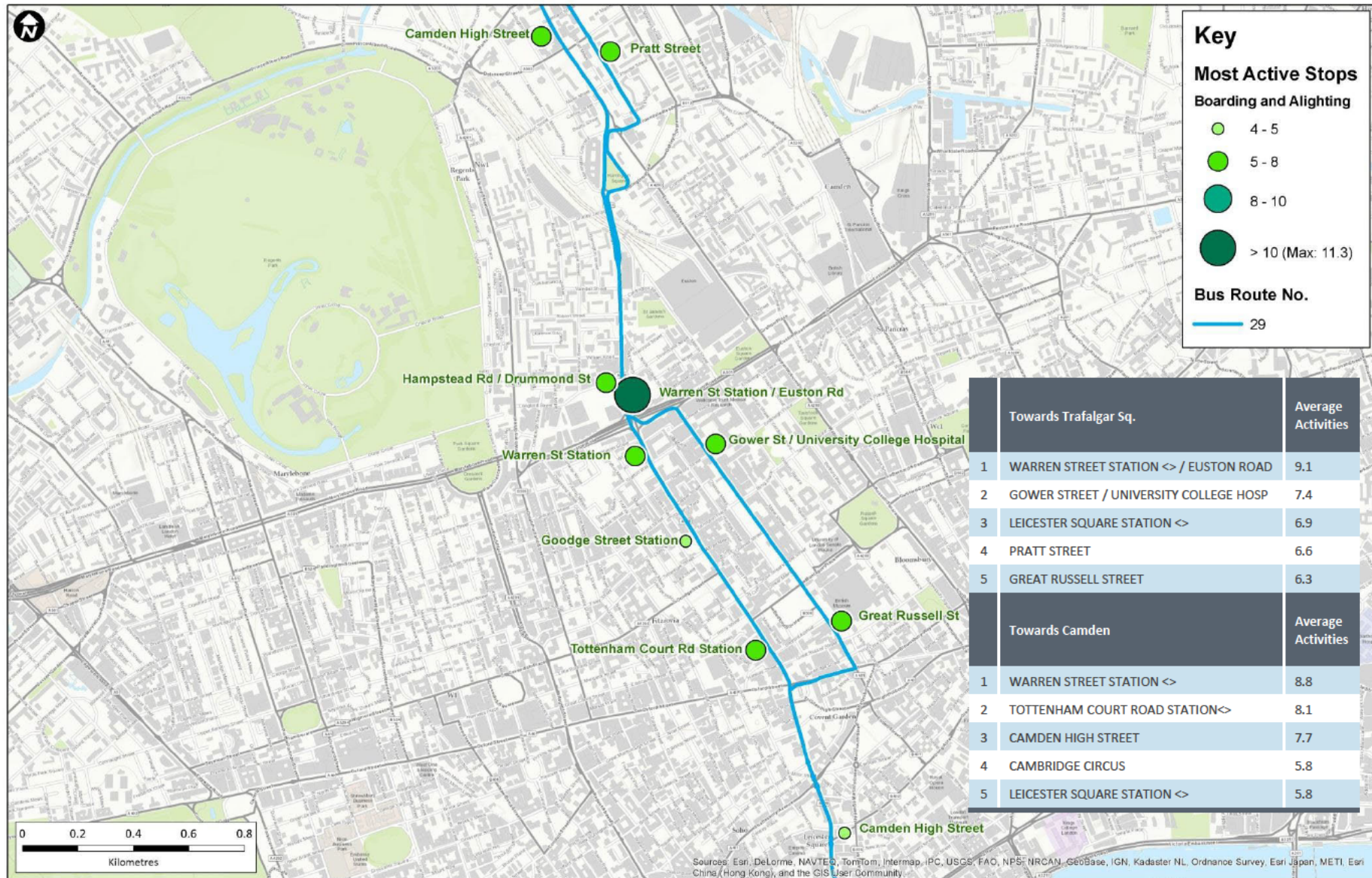


Figure 5.4: Most active stops, route 29

**Dwell Time Operational Research Study**

Bus Route 29: Average Stop Activity Levels (Most Active)



Created by: [Redacted] Last Updated: 3/20/2015 Scale: 12,086

Stop to Stop Journey Times

- 5.6 From the stop event data collected, we can calculate average stop to stop journey times between each consecutive stop. The average observed journey time to a particular stop is calculated by adding the dwell time of the previous stop to the journey time to the particular stop. Table 5.2 show aggregate route data by direction and time of day. The full data sets, split out by stop can be found in Appendix F.

Table 5.2 Average Stop to Stop Times (mm:ss)

	Before 10:00	10:00 to 16:00	After 16:00	All-day	Before 10:00	10:00 to 16:00	After 16:00	All-day
	Towards Horse Guards Parade				Towards Plumstead Station			
53	01:35	01:27	01:28	01:29	01:33	01:55	02:18	01:53
	Towards Great Central Street				Towards Deptford Bridge			
453	01:57	01:47	01:51	01:51	01:54	02:06	02:14	02:02
	Towards Grosvenor Road				Towards Royal Free Hospital			
24	01:52	01:59	01:56	01:56	01:37	02:06	01:54	01:54
	Towards Trafalgar Sq.				Towards Wood Green Station			
29	01:45	02:05	01:47	01:54	01:25	02:05	01:49	01:47

- 5.7 Inbound trips for routes 53 and 453 are longer than the mid-day and evening trips. This is explained by greater congestion. The morning period has the longest stop to stop time for both routes. Stop to stop times are slowest during the inter peak period on both route 24 and 29. The morning period between 7 and 10 am has the quickest stop to stop times on both routes.
- 5.8 Average stop to stop journey times are higher towards Deptford for the 453 and 53. The 453 has longer stop to stop journey times than the 53. Stop to stop journey time are higher towards Trafalgar Square on routes 24 and 29.

Marginal Activity Time Analysis

- 5.9 We have carried out analysis looking at the marginal activity time which is defined to be the average time for boarding and alighting activities per passenger over and above the fixed stop time.
- 5.10 Dwell times are a function of both the number of passengers who are boarding and alighting a bus, that is, the passenger activity, and any particular circumstances which may change throughout the day, for example the time of day and any unusual events. Furthermore, there is a constant time associated with dwell time which does not change with passenger activity, related to, for example, time spent waiting for the doors to open and close. Therefore, we have specified the following model to find the relationship between average dwell time and boarding/alighting activity:-

Model 1: Passenger Activity

$$\text{Dwell Time}_{53} = \alpha + (\beta * \text{Passenger Activity}_{53})$$

$$\text{Dwell Time}_{453} = \alpha + (\beta * \text{Passenger Activity}_{453})$$

$$\text{Dwell Time}_{24} = \alpha + (\beta * \text{Passenger Activity}_{24})$$

$$\text{Dwell Time}_{29} = \alpha + (\beta * \text{Passenger Activity}_{29})$$

- 5.11 Where β is the marginal boarding or alighting activity time and α is the fixed stop time. The table below illustrates the relationship that was found between dwell times and passenger

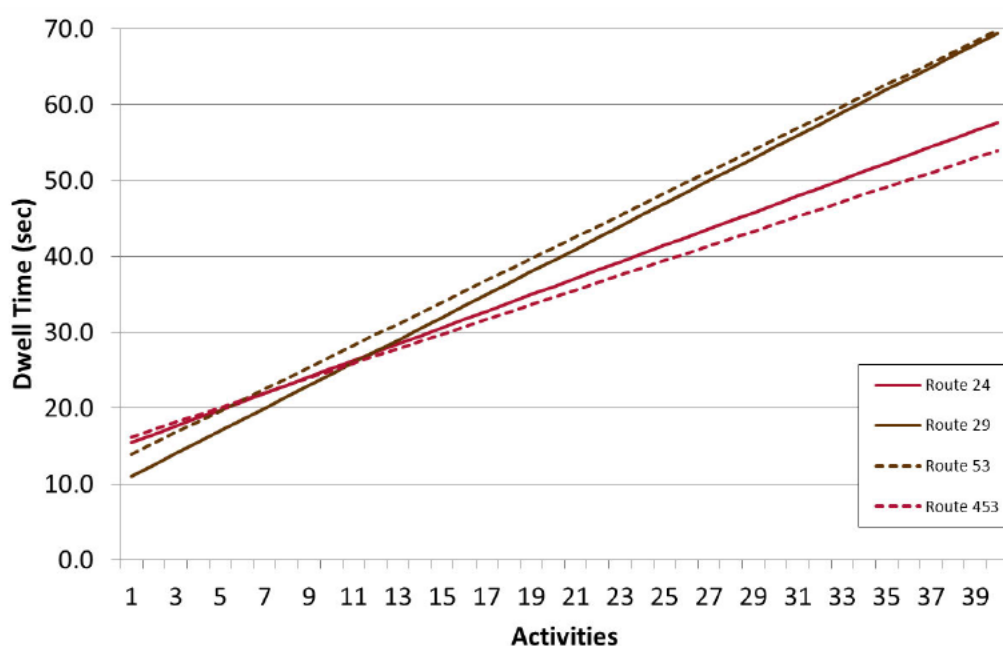
activity by route. The results are shown in terms of the coefficient estimated, the standard error on the coefficient and the t-statistic. The t-statistic is used to indicate where we can be confident that the coefficients for marginal activity and fixed stop time constants are different to zero. In general, a t-statistic greater than 1.96 means that the particular coefficient is statistically significant.

Table 5.3 Model 1: Marginal Activity Time by Route

		53, DD	453, NR-OPO	24, NR-CO	29, DD
Fixed stop constant (sec)	Coefficient	12.5	15.3	14.4	9.5
	Standard error	0.33	0.43	0.45	0.33
	t-stat	37.6	35.7	31.7	28.7
Marginal activity time (sec)	Coefficient	1.4	1.0	1.1	1.5
	Standard error	0.04	0.05	0.06	0.05
	t-stat	33.6	19.7	16.9	28.7
Adjusted R squared		0.43	0.32	0.23	0.44

- 5.12 Similar to the results of the 2008 study, shown in Appendix G, the marginal activity time of the 53 is higher than the 453 and the fixed stop time of the 53 is less than the 453. Route 453's fixed stop time is higher than on route 53 likely because of the time needed for the driver to check all three doors for no activity before closing them. The routes operating the New Routemasters have the lowest marginal activity times when compared to the routes operating the double deckers.
- 5.13 To illustrate how the model behaves, the estimated marginal activity times have been used to estimate dwell times for given levels of activity on each route. Total boarding and alighting times have been calculated by multiplying the number of activities with the marginal times as shown in Table 5.3 above. The complete tables are in Appendix H. The fixed stop time taken is also taken from Model 1.
- 5.14 Figure 5.5 shows the dwell time of each route as a function of the number of activities.

Figure 5.5: Average Dwell Time by Number of Activities



- 5.15 Figure 5.5 shows the Routemaster routes in red for ease of comparison. It is clear from the figures that with few boarders and alighters at a given stop (six passengers or fewer) the dwell times on route 53 are lower than those on route 453. However, for stops where more than six passengers board or alight the 453 is more efficient. The picture is broadly similar when comparing the 24 with the 29; up to approximately 12 boarders and alighters dwell times are lower on route 29 than on route 24. However, for stops where more than twelve passengers board or alight the 24 is more efficient.

Dwell Time Estimates by Boarding and Alighting Activity

- 5.16 In order to separate the effect of boarders and alighters on the buses' dwell times, we have specified the following model:

Model 2: Boarding and Alighting Activity

$$\text{Dwell Time}_{53} = \alpha + (\beta_1 * \text{Boarder Activity}_{53}) + (\beta_2 * \text{Alighter Activity}_{53})$$

$$\text{Dwell Time}_{453} = \alpha + (\beta_1 * \text{Boarder Activity}_{453}) + (\beta_2 * \text{Alighter Activity}_{453})$$

$$\text{Dwell Time}_{24} = \alpha + (\beta_1 * \text{Boarder Activity}_{24}) + (\beta_2 * \text{Alighter Activity}_{24})$$

$$\text{Dwell Time}_{29} = \alpha + (\beta_1 * \text{Boarder Activity}_{29}) + (\beta_2 * \text{Alighter Activity}_{29})$$

- 5.17 Where β_1 and β_2 are the marginal boarding and alighting times respectively and α is the fixed stop time. Table 5.4 illustrates the relationship between dwell times and boarding and alighting times by route.

Table 5.4 Model 2: Marginal Boarding and Alighting Times by Route

		53, DD	453, NR-OPO	24, NR-CO	29, DD
Fixed stop constant (sec)	Coefficient	12.1	15.2	14.5	9.6
	Standard error	0.32	0.42	0.45	0.32
	t-stat	38.0	36.1	32.1	30.4
Marginal boarding time (sec)	Coefficient	2.0	1.2	1.4	2.0
	Standard error	0.06	0.07	0.10	0.07
	t-stat	32.5	17.3	14.0	29.3
Marginal alighting time (sec)	Coefficient	1.0	0.7	0.8	1.1
	Standard error	0.05	0.07	0.10	0.06
	t-stat	19.9	9.6	8.3	16.6
Adjusted R squared		0.48	0.34	0.24	0.50

- 5.18 Route 53's marginal boarding time is higher than route 453's. Boarders make a greater contribution to additional dwell times because there is a transaction associated with boarding the bus which is not the case with alighters. This is reflected in the marginal alighting times which are faster than boarding times on both routes. The fixed stop time is greater on route 453 due to the extra time required to check and close 3 sets of doors.
- 5.19 Route 29's marginal boarding time is higher than route 24's. As on the 53 and 453, the marginal alighting times are faster than boarding times on both routes. The fixed stop time is greater on route 24 due to the extra time required for the customer assistant to give the driver the 'all clear' at the 3rd set of doors so the bus can proceed.
- 5.20 The marginal boarding and alighting times on both of the New Routemaster routes are faster than the comparator. This shows that the Routemasters can exchange passengers faster at

stops than the traditional double-decker. This is expected as passengers can board and alight at any one of the three doors.

- 5.21 In 2008, a third model was presented which separated out the effect of boarders by their method of payment. Due to the preponderance of Oyster card use and the removal of the option to pay by cash, this model has not been replicated in 2015.

Comparison with Previous Surveys

Dwell Times

- 5.22 To assess how average dwell times and marginal activity times have changed since the previous studies conducted in 2003 and 2008, the three datasets have been compared. The results of these are given in the section below and are for the common sections of the routes only.

- 5.23 Table 5.5 provides a summary of the dwell time profiles for routes 53 and 453 by year.

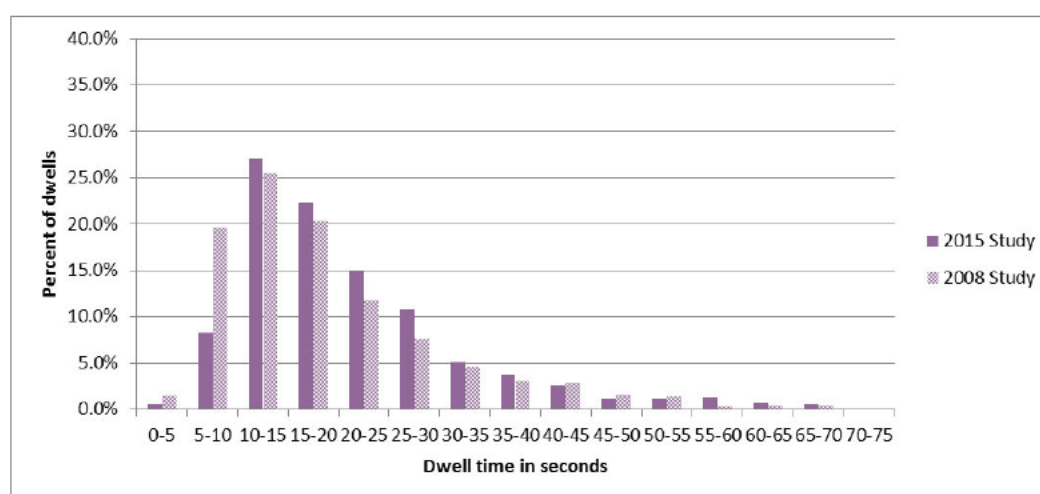
Table 5.5 Summary of Average Dwell Times by Route and by Study (Routes 53 and 453)

	Route 53					Route 453				
	2003	2008	2015	% 03-08	% 08-15	2003	2008	2015	% 03-08	% 08-15
Average Boarders	2.8	3.1	2.8	11%	-11%	3.3	4.1	3.5	24%	-14%
Average Alighters	3.0	3.1	3.0	3%	-3%	3.1	4.4	3.1	42%	-30%
Average Total Activity	5.8	6.3	5.8	8%	-8%	6.4	8.4	6.6	32%	-21%
Average Dwell Time (sec)	16.6	17.7	20.8	7%	17%	14.7	16.8	21.7	14%	29%
Average Time per Boarder/Alighter	2.9	2.8	3.6	-1%	28%	2.3	2.0	3.3	-14%	64%
Sample Size	1584	840	1492	-46%	78%	973	746	825	-23%	11%

- 5.24 Table 5.5 shows that average dwell times have increased since 2008 for both routes. On both routes, the average dwell time increase comes in spite of a decrease in total activity levels. Please note that the 2008 sample sizes were lower than those arising in both 2003 and 2015. This is largely due to disruption during the 2008 data collection exercise.

- 5.25 Figure 5.6 presents a comparison of the distribution of dwells on route 53 between the 2008 and 2015 studies.

Figure 5.6: Comparison of the distribution of dwells on route 53, 2008 and 2015



- 5.26 As seen in Figure 5.6, in the 2015 study, the proportion of dwells in the 5-10 second range has decreased when compared to the 2008 study. This corresponds with a marginal increase in dwells in the 10-40 second ranges.
- 5.27 Publicly available statistics published by Transport for London suggest that the rise in bus patronage since 2003 is approximately 40% although this has leveled off in recent years with the increase since 2008 standing at approximately 6%¹. This increase in bus patronage is not fully reflected in the 2015 numbers when compared to the 2008 data which could be explained by an increase in bus frequency. There has been an increase in average total boarders and alighters on the 453 since 2003. The average number of boarders and alighters has remained similar throughout the three studies at approximately three boarders and three alighters.
- 5.28 The decrease in passenger activities is not concentrated in particular sections of route, the trend is broadly reflected at stops along the route. The change in number of activities and dwell times by stop since 2003 and 2008 can be seen in Appendix I.
- 5.29 Table 5.6 and Table 5.7 show comparative dwell time statistics by time of day from the 2003, 2008 and 2015 studies.
- 5.30 The average total activities per stop in each period of the day has decreased since 2008 on the 53 and 453. The largest decreases have been in the inter-peak period, reversing the observation in the 2008 study. On both routes this has brought the number of activities back to the levels seen in 2003. This could be explained by an increase in frequency on the 53 and 453 which helps to spread the passenger load across more buses.

¹ *Travel in London Report 7*, Transport for London, 2014.

Table 5.6: Dwell Time Statistics by Time of Day, Study. Route 53

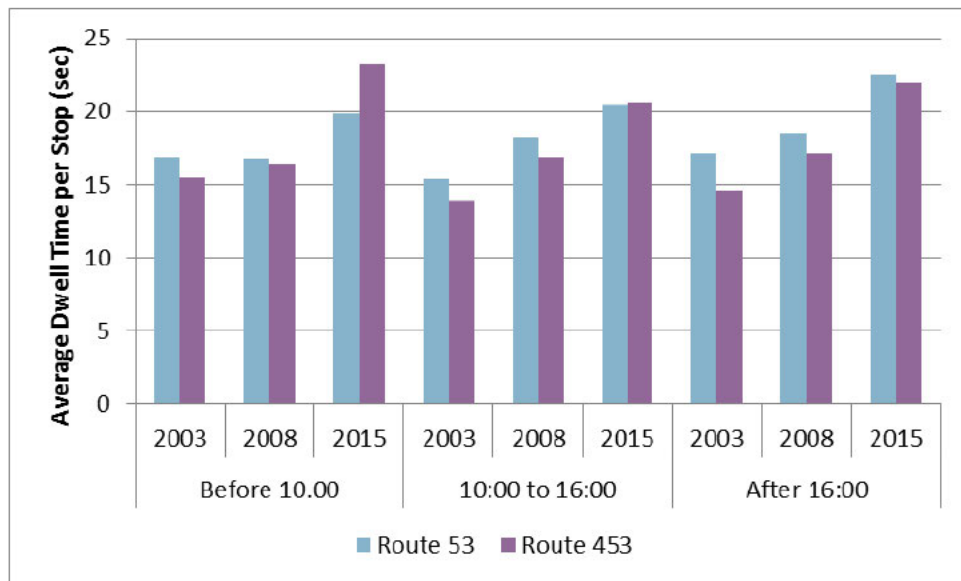
	Route 53											
	Before 10:00				10:00 to 16:00				After 16:00			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Average boarders	2.9	3.2	3.1	-3%	2.4	3.1	2.5	-18%	3	2.8	2.8	1%
Average alighters	3	2.9	2.9	0%	2.7	3.2	2.7	-16%	3.8	3.7	3.8	4%
Average Total Activity	5.9	6.1	6.0	-2%	5.1	6.3	5.2	-17%	6.8	6.6	6.7	1%
Average Dwell Time (sec)	16.9	16.8	19.9	18%	15.4	18.2	20.5	13%	17.1	18.5	22.5	21%
Average Time per Boarder/Alighter (sec)	2.9	2.8	3.3	18%	3	2.9	3.9	36%	2.5	2.8	3.4	20%
Sample Size	419	353	429	22%	733	328	716	118%	432	159	347	118%

Table 5.7: Dwell Time Statistics by Time of Day, Study. Route 453

	Route 453											
	Before 10:00				10:00 to 16:00				After 16:00			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Average boarders	4	4.9	4.5	-8%	2.4	3.4	2.9	-16%	3.9	4.2	3.8	-9%
Average alighters	3.1	4	3.8	-5%	2.5	3.8	2.3	-39%	4	5.7	3.9	-31%
Average Total Activity	7.1	8.9	8.3	-6%	4.9	7.3	5.2	-29%	7.9	9.9	7.8	-22%
Average Dwell Time (sec)	15.5	16.4	23.2	42%	13.9	16.9	20.7	22%	14.6	17.1	22.0	29%
Average Time per Boarder/Alighter (sec)	2.2	1.8	2.8	55%	2.8	2.3	4.0	73%	1.8	1.7	2.8	67%
Sample Size	291	224	234	4%	406	335	422	26%	276	187	169	-10%

Figure 5.7 illustrates average dwell times for both routes across the three time periods: AM Peak, Inter-Peak and PM Peak.

Figure 5.7: Average dwell times per stop by time of day, year and route.



- 5.31 Average dwell times per stop have increased over each period for both routes since 2003 and 2008. The most significant increase has been on the 453 in the AM peak. A complete summary of comparative dwell time statistics by stop can be found in Appendix I.

Marginal Activity Times

- 5.32 Comparing marginal activity times between years will provide understanding of how the introduction of Oyster cards and the removal of cash fares have made an impact on dwell times. We have used the marginal activity time regression model from the dwell time analysis to make comparisons across years.

Table 5.8 Model 1: Passenger Activity by Route and by year

	Route 53					Route 453				
	2003	2008	2015	% 03-08	% 08-15	2003	2008	2015	% 03-08	% 08-15
Fixed stop constant (sec)	8.8	9.8	12.5	11%	28%	10.1	11.9	15.3	18%	29%
Marginal activity time (sec)	1.3	1.3	1.4	0%	8%	0.7	0.6	1.0	-18%	67%

- 5.33 Table 5.8 shows that fixed stop constants have increased since 2008. Marginal activity has also increased on both routes and to a greater extent on the 453 than the 53.

- 5.34 We have used the marginal boarding and alighting regression model to further analyze differences between marginal activity times over the two studies.

Table 5.9 Model 2 Boarding and Alighting Activity by year

	Route 53					Route 453				
	2003	2008	2015	% 03-08	% 08-15	2003	2008	2015	% 03-08	% 08-15
Fixed stop constant (sec)	8.9	9.6	12.1	8%	26%	10	11.4	15.2	14%	33%
Marginal boarding time (sec)	1.7	1.6	2.0	-4%	25%	0.8	0.8	1.2	4%	50%
Marginal alighting time (sec)	1.0	1.0	1.0	0%	0%	0.6	0.4	0.7	-26%	75%

- 5.35 Marginal boarding times have increased on both routes since 2008 but particularly on the 453. The marginal alighting time on route 53 remains the same as in the previous two surveys at 1.0 second whilst on the 453 the marginal alighting time has increased by 75% to 0.7 seconds. Fixed stop times on both routes have increased since 2008 which may be due to rising levels of traffic congestion i.e. parked cars and traffic on the road which impedes the bus from pulling out from the stop.

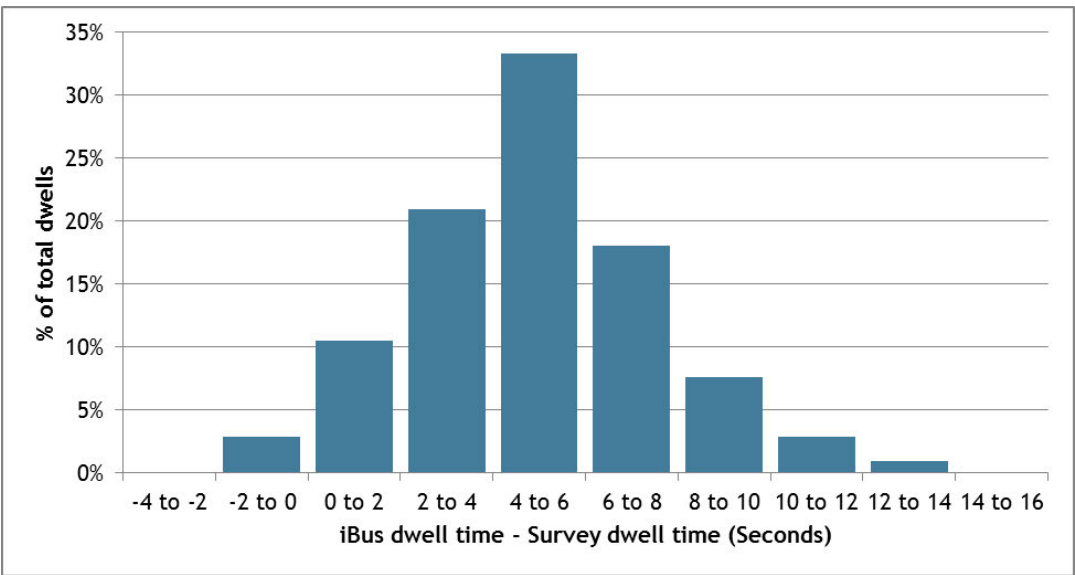
Effect of cash free buses

- 5.36 It was not possible to test the effect of cash free buses by comparing with the 2008 study. This is due to the extremely low rate of cash usage in the 2008 study. Only 31 of 7,613 boarding events were recorded as using cash payment. This is less than half of one percent of all passengers and it is therefore not possible to analyse this change with any statistical significance. The change in dwell times between 2003 and 2008 reported in the 2008 study is therefore considered the most relevant indicator of the effect associated with the reduction/elimination of cash payments.

Comparison of iBus data

- 5.37 A sample of the manually collected survey data was compared to the electronically collected iBus data. A subset of the data for route 24 is presented in Figure 5.8.

Figure 5.8: Comparison of iBus data and survey data



- 5.38 As shown in Figure 5.8, the iBus data over-estimates the length of dwells when compared to the survey data. There is a large amount of variability in the comparison data with the difference in dwells ranging from under-estimating by 2 seconds to over-estimating by up to 14 seconds. This suggests that iBus data would be inaccurate to use in a predictive dwell time model.

- 5.41 :

6 Journey Time Analysis and Results

Introduction

- 6.1 Journey time data was captured through surveys performed as described in Section 3. Records taken at individual stops were matched together by bus registration number and by departure and arrival times. To account for outliers and atypical journey times, journeys that had times more or less than 1.5 times the interquartile range from the median were excluded.
- 6.2 Table 6.1 and Table 6.2 show the number of journeys by direction on the overlapping section of each route pair.

Table 6.1 Number of Journeys Excluded (Routes 53 and 453)

	Towards Deptford			Towards Whitehall		
	Route 53	Route 453	Total	Route 53	Route 453	Total
Journeys collected	165	219	384	207	223	430
Journeys after exclusions	149	205	354	188	209	397
% of journeys excluded	10%	6%	8%	9%	6%	8%

Table 6.2 Number of Journeys Excluded (Routes 24 and 29)

	Towards Trafalgar			Towards Camden		
	Route 24	Route 29	Total	Route 24	Route 29	Total
Journeys collected	314	446	760	281	407	688
Journeys after exclusions	283	401	684	255	377	632
% of journeys excluded	10%	10%	10%	9%	7%	8%

- 6.3 Table 6.3 shows the number of matched journeys by time of day and direction for the 53 and 453 on their overlapping section. The matched journeys are split by a ratio of roughly 1.2 : 2 : 1 for the AM, Inter Peak and PM Peak respectively. The split by time of day for the 53 and 453 is broadly similar, which allows for fair comparison between the two routes' average journey times.

Table 6.3 Matched Journey Profile by Time of Day (Routes 53 and 453)

	Route 53	%	Route 453	%	Total	%
Before 10.00	82	24%	136	33%	218	29%
10.00 to 16.00	175	52%	181	44%	356	47%
After 16.00	80	24%	97	23%	177	24%
Total	337	100%	414	100%	751	100%

- 6.4 Table 6.4 shows the number of matched journeys by time of day and direction for the 24 and 29 on their overlapping section. The matched journeys are split by a ratio of roughly 1 : 2 : 1 for the AM, Inter Peak and PM Peak respectively. The split by time of day for the 24 and 29 are the same, which allows for fair comparison between the two routes' average journey times.

Table 6.4 Matched Journey Profile by Time of Day (Routes 24 and 29)

	Route 24	%	Route 29	%	Total	%
Before 10.00	124	23%	202	26%	326	25%
10.00 to 16.00	270	50%	366	47%	636	48%
After 16.00	144	27%	210	27%	354	27%
Total	538	100%	778	100%	1316	100%

Average Journey Times – Overlapping Sections

- 6.5 The following table shows the average journey time recorded for the 53 and 453 by direction; for buses going towards Whitehall and for buses going towards Deptford over the routes' overlapping section.

Table 6.5 Average Journey Times on the 53 and 453 by Direction and Route (Minutes)

	Route 53		Route 453	
	Towards Whitehall	Towards Deptford	Towards Whitehall	Towards Deptford
Average Journey Time	29.6	35.6	31.5	35.6
95% Confidence Interval	30.2	36.6	31.9	36.6
	28.9	34.5	31.2	34.6
Standard Deviation (min)	4.1	7.2	2.6	7.4
Maximum (min)	39.9	56.6	37.7	53.7
Minimum (min)	19.3	23.6	25.5	18.6
Sample Size	149	188	205	209

- 6.6 Average journey times are marginally longer towards Deptford on both the 53 and the 453. Note also the larger standard deviation towards Deptford on both routes which suggests a greater degree of journey time variability in this direction. The average journey times corroborates the average stop to stop journey times found in Table 5.2 which shows that journey times between stops are lower going towards Deptford and the 453 going towards Deptford has the highest journey times.
- 6.7 Table 6.6 shows the average journey time recorded for the 24 and 29 by direction; for buses going southbound towards Trafalgar and for buses going northbound towards Camden over the routes' overlapping section.

Table 6.6 Average Journey Times on the 24 and 29 by Direction and Route (Minutes)

	Route 24		Route 29	
	Towards Trafalgar	Towards Camden	Towards Trafalgar	Towards Camden
Average Journey Time	28.1	25.4	25.8	23.8
95% Confidence Interval	28.5	25.8	26.1	24.1
	27.8	25.1	25.6	23.5
Standard Deviation (min)	2.9	3.0	2.7	3.1
Maximum (min)	34.9	32.2	32.7	30.7
Minimum (min)	21.3	18.8	19.3	16.9
Sample Size	283	255	401	377

6.8 Average journey times are marginally longer towards Trafalgar on both the 24 and the 29. Note however the larger standard deviation towards Camden on both routes which suggests a greater degree of variability in this direction. The average journey times corroborates the average stop to stop journey times found in Table 5.2 which shows that journey times between stops are lower going towards Camden and the 24 going towards Trafalgar has the highest journey times.

6.9 Table 6.7 shows average journey times going towards Whitehall on the 53 and 453 by time of day. Average journey times going towards Whitehall are highest in the AM Peak on both routes. The 53's journey times are lower than route 453 across all time periods but particularly the PM peak.

Table 6.7 Average Journey Time towards Whitehall (Routes 53 and 453)

	Route 53			Route 453		
	Before 10.00	10.00 to 16.00	After 16.00	Before 10.00	10.00 to 16.00	After 16.00
Average Journey Time	31.6	29.6	28.1	33.0	31.0	30.4
95% Confidence Interval	33.3	30.5	29.0	33.6	31.4	31.2
	30.0	28.7	27.1	32.4	30.5	29.5
Sample Size	28	82	39	68	95	42

6.10 Table 6.8 shows average journey times going towards Deptford on the 53 and 453 by time of day. Average journey times going towards Deptford are highest in the PM peak on both routes. Journey times are lower on route 453 at all times except during the PM peak where journey times are marginally lower on the 53.

Table 6.8 Average Journey Time towards Deptford (Routes 53 and 453)

	Route 53			Route 453		
	Before 10.00	10.00 to 16.00	After 16.00	Before 10.00	10.00 to 16.00	After 16.00
Average Journey Time	30.9	35.2	42.7	29.8	35.0	43.7
95% Confidence Interval	32.1	36.6	44.2	30.8	36.4	44.7
	29.6	33.8	41.1	28.9	33.6	42.6
Sample Size	54	93	41	68	86	55

6.11 Table 6.9 shows average journey times going towards Trafalgar on the 24 and 29 by time of day. Average journey times going towards Trafalgar are highest in the interpeak on both routes. Journey times are lower on route 29 across all time periods.

Table 6.9 Average Journey Time towards Trafalgar (Routes 24 and 29)

	Route 24			Route 29		
	Before 10.00	10.00 to 16.00	After 16.00	Before 10.00	10.00 to 16.00	After 16.00
Average Journey Time	26.2	29.5	27.5	24.3	27.1	25.5
95% Confidence Interval	26.8	30.0	27.9	24.7	27.4	25.9
	25.6	29.1	27.0	23.8	26.7	25.1
Sample Size	75	136	72	118	176	107

- 6.12 Table 6.10 shows average journey times going towards Camden on the 24 and 29 by time of day. Average journey times going towards Camden are highest in the interpeak on both routes. Journey times are lower on route 29 across all time periods.

Table 6.10 Average Journey Time towards Camden (Routes 24 and 29)

	Route 24			Route 29		
	Before 10.00	10.00 to 16.00	After 16.00	Before 10.00	10.00 to 16.00	After 16.00
Average Journey Time	22.3	26.6	25.4	20.6	25.0	24.1
95% Confidence Interval	23.0	27.0	25.9	21.2	25.4	24.6
	21.6	26.1	24.9	20.0	24.6	23.7
Sample Size	49	134	72	84	190	103

Comparison with Previous Surveys – Overlapping Sections

- 6.13 In this section we will compare the 2015 journey time survey results for the overlapping parts of routes 53 and 453 with the previous surveys conducted in 2008 and 2003. Due to the works causing route 53 to terminate early, the average journey time between Lambeth North and Hoseguards Parade over the two weeks preceding the construction has been added to the journey time to ensure the data is comparable to previous surveys.

Table 6.11 Route 53 Comparative Journey Time Statistics

	Route 53									
	Towards Whitehall					Towards Deptford				
	2003	2008	2015	% 03-08	% 08-15	2003	2008	2015	% 03-08	% 08-15
Average Journey Time (min)	32.7	36.0	36.3	10%	1%	39.3	37.3	43.4	-5%	16%
Maximum (min)	46.8	53.7	46.6	15%	-13%	60.2	59	64.4	-2%	9%
Minimum (min)	21.9	27.0	26.1	23%	-3%	21.3	27.5	31.5	29%	14%
Sample Size	184	115	149	-38%	30%	226	114	188	-50%	65%

- 6.14 Table 6.11 presents comparative statistics for route 53. It shows that average journey times have increased in both directions since the surveys carried out in 2003 and 2008. Journeys towards Deptford have increase by 16% or 6.1 minutes. Journeys to towards Whitehall have only slightly increased.
- 6.15 Table 6.12 presents the same comparative statistics for route 453. A comparison of the average journey times collected iBus have shown that the construction works had an effect on

the running times of the buses. The change in running times have been accounted for to ensure the data is comparable to the previous surveys.

Table 6.12 Route 453 Comparative Journey Time Statistics

	Route 453									
	Towards Whitehall					Towards Deptford				
	2003	2008	2015	% 03-08	% 08-15	2003	2008	2015	% 03-08	% 08-15
Average Journey Time (min)	32.7	35.7	39.4	9%	10%	40.2	38.1	44.7	-5%	17%
Maximum (min)	49.6	37.1	45.6	-25%	23%	64.1	40.2	62.8	-37%	56%
Minimum (min)	20.6	34.1	33.3	65%	-2%	21.5	36.1	27.7	68%	-23%
Sample Size	283	98	205	-65%	109%	294	82	209	-72%	155%

- 6.16 Table 6.14 shows that average journey times have increased in both directions since the surveys were carried out in 2003 and 2008, and are now at their lowest recorded level. Journeys towards Deptford have increase by 17% or 6.6 minutes. Journeys to towards Whitehall have increase by 10% or 3.7 minutes.

Average Journey Times – Discrete Sections

- 6.17 The following table shows the average journey time recorded for the 453 by direction; for buses going towards Marylebone and for buses going towards Lambeth over the route's discrete section i.e. that which it does not share with the 53.

Table 6.13 Average Journey Times on the 453 Discrete Section by Direction (Minutes)

	Route 453	
	Towards Marylebone	Towards Lambeth
Average Journey Time	40.6	43.5
95% Confidence Interval	41.1	44.1
	40.2	43.0
Standard Deviation (min)	3.2	4.3
Maximum (min)	47.7	53.6
Minimum (min)	33.2	34.1
Sample Size	206	226

- 6.18 Average journey times are marginally longer towards Lambeth. The standard deviation is also larger towards Lambeth which suggests a greater degree of journey time variability.
- 6.19 Table 6.14 shows the average journey time recorded for the 24 by direction; for buses on the northern section towards Hampstead (northbound) and Camden (southbound) and on the southern section towards Pimlico (southbound) and Trafalgar (northbound) over the route's discrete section i.e. that which it does not share with the 29.

Table 6.14 Average Journey Times on the 24 Discrete Sections by Direction (Minutes)

	Route 24 (Northern Section)		Route 24 (Southern Section)	
	Towards Hampstead	Towards Camden	Towards Pimlico	Towards Trafalgar
Average Journey Time	14.9	15.9	28.5	29.3

95% Confidence Interval	15.2	16.2	28.8	29.7
	14.7	15.6	28.1	28.9
Standard Deviation (min)	2.1	2.3	2.7	3.1
Maximum (min)	19.6	21.7	34.6	37.5
Minimum (min)	10.0	10.8	22.3	21.5
Sample Size	244	254	273	253

6.20 Average journey times are marginally longer towards Camden on the northern section and towards Trafalgar on the southern section. Note also the larger standard deviation towards Camden and Trafalgar which suggest a greater degree of journey time variability in these directions.

6.21 Table 6.15 shows the average journey time recorded for the 29 by direction; for buses on the northern section towards Wood Green (northbound) and Camden (southbound) over the route's **discrete section** i.e. that which it does not share with the 24.

Table 6.15 Average Journey Times on the 29 Discrete Section by Direction (Minutes)

	Route 29 (Northern Section)	
	Towards Wood Green	Towards Camden
Average Journey Time	40.7	39.5
95% Confidence Interval	41.3	39.8
	40.1	39.3
Standard Deviation (min)	5.7	2.6
Maximum (min)	53.6	45.6
Minimum (min)	27.8	33.5
Sample Size	375	407

6.22 Average journey times are marginally longer towards Wood Green. The larger standard deviation towards Wood Green also suggests a greater degree of journey time variability in this direction.

A Data Collection App Screen Shots

Surveyor

Surveyor Name

Route

53

Starting stop

LAMBETH NORTH STATION <>

Door

Rear – New Routemaster only!

Key

Key

Bus Registration number

Bus registration number

No. of people counted before start of survey – enter 0 if beginning of route

Number of people

Next

LAMBETH NORTH STATION <>

Wheels Stop

Bus Continues

Doors Open

Doors Don't/Stay Open

Contactless	+2	0	-
Contactless Rejected	+2	0	-
Pass shown	+2	0	-
No fare presented	+2	0	-
One More Journey	+2	0	-
Alighters	+2	0	-

Doors Close

Wheels Move

Next

Select any of the following which occurred at this stop

☐ Wait for Late Boarder

☐ Slow Boarders/alighters – Elderly, Infirm, with Luggage

☐ Footway crowding impeding Boarding/alighting

☐ Bus crowding impeding Boarding/alighting

☐ Obstruction preventing Bus pulling to kerb

☐ Vehicle (inc. other bus) parking in bus stop

☐ Passenger sent to driver from rear

Any other notes:
[Enter text here]

Next

Wheelchair On	0	-
Wheelchair Off	0	-
Pushchair On	0	-
Pushchair Off	0	-

Next

Are you confident that the data collected at this stop was collected accurately

No Yes

Did anyone board or alight between stops?

Boarder	+2	0	-
Alighter	+2	0	-

Next

How many people were on the bus at the last stop? – enter 0 if end of route.

Number of people on the bus

Was this surveyed run a complete run from end to end of the full route?

No

Yes

Compose

```

,,,,,],["ELEPHANT & CASTLE /
LONDON
ROAD",12:31:44",12:31:47",,"12
:31:45",,"12:31:46",0",2",0",0",
0",0",0",0",0",0",0",0",0",0",0",
",0",0",0",0],["DEPTFORD HIGH
STREET",,"12:32:09",,"",
,,,,,,0",0"],["
DEPTFORD BRIDGE
[DLR]",,"12:32:09",,"",
,,,,,,],["yes"]
,5

```

q w e r t y u i o p

a s d f g h j k l

⬆ z x c v b n m ⬆

?123 , . ⬅

B Boarding Time Survey – Briefing Notes

Introduction

We will be conducting boarding time surveys on four London Bus routes (**53 & 453** and **24 & 29**) between 19 January and 06 February. The survey data will be used to assess the difference in dwell times between the classic London Double Decker and the New Routemaster. We will be collecting information on boarding and alighting passengers and dwell times at stops on each route.

Survey

When and where you will be working

Surveying will be carried out on weekdays from 7am to 7pm. You will be working 6 hour shifts, either from 7am to 1pm or 1pm to 7pm. For each shift you will be allocated a bus route on which to carry out the survey. On the New Routemasters (routes 453 & 24) you will be working in a group of 3. On the classic double-deckers (routes 53 & 29) you will be working in pairs. The survey schedule, including whom you will work with and on which route will be provided by Mahesh.

You will be instructed to board the first available bus of the route you are surveying and stay on the bus until the designated end stop. Details are below:

Bus stop letters are given to help you identify the correct stop, but please note that the same letters may be used for different stops along the route. For example there are two stops with the letter D. You should therefore primarily use the stop description and hyperlink to find the correct stop.

You will also need to count the number of people on the bus when you board and alight. At the beginning or end of the route, you will record the number of people as '0' and ensure you correctly count the number of people boarding or alighting. When you board the bus part way through its route, you will need to board one stop early, count and record the number of people on the bus and then take your position to begin the dwell survey. Conversely, when the survey is complete, you will need to continue on the bus for one additional stop to count the number of people that are on the bus after the survey is complete. Table 1 shows the stops to board, begin the survey, conclude the survey and alight the bus.

Route number	Bus Type	Door	Direction	Board Bus	Start Dwell survey	End Dwell survey	Alight Bus
53	New Routemaster	Front, Middle, Rear	towards Griffin Road / Plumstead Station (East)		Lambeth North (<u>Stop C</u>)	Deptford Bridge (<u>Stop Y</u>)	Egerton Drive (<u>Stop NA1²</u>)
			towards Horse Guards Parade (West)	Egerton Drive (<u>Stop N</u>)	Deptford Bridge (<u>Stop T</u>)	Lambeth North (<u>Stop B</u>)	
453	Classic Double decker	Front, Rear	towards Deptford Bridge (East)	Great Central Street (<u>Stop M</u>)	Great Central Street (<u>Stop M</u>)	Deptford Bridge (<u>Stop S</u>)	Deptford Bridge (<u>Stop S</u>)
			towards Great Central Street (West)	Deptford Bridge (<u>Stop T</u>)	Deptford Bridge (<u>Stop T</u>)	Great Central Street (<u>Stop M</u>)	Great Central Street (<u>Stop M</u>)
24	New Routemaster	Front, Middle, Rear	towards Royal Free Hospital (North)	Horse Guards Parade (<u>Stop NA2</u>)	Trafalgar Square / Charing Cross Stn (<u>Stop C</u>)	Camden Town Station (<u>Stop X</u>)	Hartland Road / Camden Market (<u>Stop CQ</u>)
			towards Grosvenor Road (South)	Camden Gardens (<u>Stop D</u>)	Camden Town Station (<u>Stop S</u>)	Trafalgar Square / Charing Cross Stn (<u>Stop D</u>)	Whitehall / Trafalgar Square (<u>Stop N</u>)
29	Classic Double decker	Front, Rear	towards Wood Green Station (North)	Trafalgar Square / Charing Cross Stn (<u>Stop C</u>)	Trafalgar Square / Charing Cross Stn (<u>Stop C</u>)	Camden Town Station (<u>Stop Y</u>)	Camden Town / Camden Road (<u>Stop N</u>)
			towards Trafalgar Square / Charing Cross Stn (South)	Camden Road Station (<u>Stop E</u>)	Camden Town Station (<u>Stop S</u>)	Trafalgar Square / Charing Cross Stn (<u>Stop D</u>)	Trafalgar Square / Charing Cross Stn (<u>Stop D</u>)

Description of routes

- Bus route 53 is a Double Decker bus route that runs from Whitehall to Plumstead and vice versa. For this route you will only need to survey the section from Whitehall to Deptford Bridge and vice versa.
 - **Outbound (eastbound):** Beginning at Lambeth North (Stop C) you will board the empty bus, recording 'O' people on the bus and count the number of people that board with you and the dwell time as you normally would on your smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). When you reach Deptford Bridge (Stop Y), you will record your last dwell (finish recording dwell times and boarders and alighters) and stay on the bus for one more stop counting the remaining passengers. You will then need to alight the bus at the next stop, Egerton Drive (NA1).
 - **Inbound (westbound):** Board the bus Egerton Drive (Stop N) and once the doors have closed behind you, count the number of people already on board with you and record this on your smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). Begin recording dwells at Deptford Bridge (Stop T). When you reach Lambeth North (Stop B), you will conclude the study (finish recording dwell times and boarders and alighters) and stay on the bus for one more stop counting the remaining passengers. You will then need to alight the bus at the next stop.
- Bus route 453 is a New Routemaster bus route that runs from Marylebone to Deptford and vice versa. For this route you will be surveying the whole length of the route in both directions.

² Stop listed as NA have not been assigned a stop number by TfL and must be found by their stop name

- Outbound (eastbound):** Beginning at Great Central Street (**Stop M**) you will board the empty bus, recording '0' people on the bus and count the number of people that board with you and the dwell time as you normally would on your smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). When you reach Deptford Bridge (**Stop S**), you will conclude the study by recording the dwell time and alighters, alight the bus yourself, recording the number of people remaining on the bus as '0'.
- Inbound (westbound):** Board the bus travelling in the opposite direction at Deptford Bridge (**Stop T**), you will board the empty bus, recording '0' people on the bus and count the number of people that board with you and the dwell time as you normally would on your smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). When you reach Great Central Street (**Stop M**), the terminus of the route, you will conclude the survey by recording the number of boarders and alighters, alighting the bus yourself, and record the number of people remaining on the bus as '0'.
- Bus route **24** is a New Routemaster bus route that runs from Pimlico to Hampstead Heath and vice versa. For this route you will only need to survey the section between Trafalgar Square to Camden Town Station. **Please note:** Route 24 will need to begin surveys at 06:30am and completed by 16:30.
 - Outbound (northbound):** Beginning at Horse Guards Parade (**Stop NA2**), you will board the bus, and once the doors have closed behind you, count the number of people already on board including yourself and record this on your smartphone. The dwell study begins at the next stop, Trafalgar Square / Charing Cross Stn (**Stop C**). At the end of the dwell survey, after Camden Town Station (**Stop X**), you will conclude the study (finish recording dwell times and boarders and alighters) and stay on the bus for one more stop counting the remaining passengers. You will then need to alight the bus at the next stop, Hartland Road / Camden Market (**Stop CQ**).
 - Inbound (southbound):** Walk to Camden Gardens (**Stop D**), you will board the bus, and once the doors have closed behind you, count the number of people already on board with you and record this on your smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). Begin recording dwells at Camden Town Station (**Stop S**), the next stop. At the end of the dwell survey, after Trafalgar Square / Charing Cross Stn (**Stop D**), you will conclude the study (finish recording dwell times and boarders and alighters) and stay on the bus for one more stop counting the remaining passengers. You will then need to alight the bus at the next stop, Whitehall / Trafalgar Square (**Stop N**).
- Bus route **29** is a Double Decker bus route that runs from Trafalgar Square to Wood Green and vice versa. For this route you will only need to survey the section between Trafalgar Square and Camden Town Station.
 - Outbound (northbound):** Beginning at Trafalgar Square / Charing Cross Stn (**Stop C**) you will board the empty bus, counting the number of people that board with you and the dwell time on your Smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). When you reach Camden Town Station (**Stop Y**), you will record your last dwell (finish recording dwell times and boarders and alighters) and stay on the bus for one more stop counting the

remaining passengers on board. You will then need to alight the bus at the next stop, Camden Town / Camden Road (**Stop N**).

- **Inbound** (southbound): Walk to Camden Road Station (**Stop F**), you will board the bus, and once the doors have closed behind you, count the number of people already on board with you and record this on your smartphone (accurate passenger counts are more important than the dwell times at the start and end of the routes). Begin recording dwells at Camden Town Station (**Stop S**), the next stop. At the end of the route, Trafalgar Square / Charing Cross Stn (**Stop D**), count the number of people alighting the bus and alight yourself.

Important Notes:

- When counting the people on the bus, always include yourself in the count
- Where this can be avoided, do not survey the same bus in subsequent surveys.

What you will be doing

For the data collection you will be using smart phones with survey software installed on them. In the next section we will present the data entry screens followed by instructions on how to use them.

Once you board the bus you will need to introduce yourself to the bus drivers. You will also be provided with letters of authority from TfL, which you will need to show to the bus drivers when boarding. If for any reason bus driver does not allow you to perform the survey, alight bus and board the next one available. While on board you should sit close to the driver or close to the door that has been assigned to you, in order to clearly observe passengers boarding and alighting. While on board you should remain seated for your safety.

We are most interested in boarding/alighting times where **nothing unusual has occurred**. Should you board a bus with a clear operational malfunction e.g. ticket machine is broken or doors take too long to open, etc then alight the bus and board the next bus coming along. The stop where you alight should be coded as having an unusual event and an appropriate description provided. Also if there are any serious events on the route that heavily delay the bus, e.g. car accident ahead and bus has not moved for 20 – 30 min, then contact Mahesh who will instruct you.

At the beginning of your shift you must ensure your phone and battery pack has a full charge. If it does not, then please contact Mahesh immediately.

Survey Conduct

Please do not use mobile phones during the shift so that you remain focussed throughout your shift.

Screenshots

Screen shots of the program screens are provided below. Bullet points indicate the required inputs, how to deal with certain situations and other notable features.

Important notes:

- Only use the phone for the dwell time survey.
- Do not exit the application for any reason; this could corrupt the data that has been collected.
- You should have sufficient battery life for the phone to remain on throughout your shift. There is no need to turn it off between dwells. If your power is below 40% use a battery pack to charge the phone. If your battery packs are dead, phone TDC and a fresh one will be delivered to you.

INTRODUCTION

SCREEN SHOT OF OPENING SCREEN

- You should enter the first three letters of your name on the opening screen.
- Select which bus route you are surveying
- Select door that you are surveying
- Select the door you a surveying NOTE: only chose Rear if you are on a New Routemaster.
- Enter a key number. This number must be agreed with the rest of your team before inputting. TDC will provide guidance on how to choose this number.

Dwell time web service

Surveyor

Route Number

Stop

Door

Key

Bus Registration number

No. of people counted before start of survey – enter 0 if beginning of route

- **Bus Registration no.** – enter the details from the number plate.
- **No. of people on bus before start of survey – enter 0 if beginning of route** – for routes where you board at the beginning of the route, enter 0 and ensure you count the number of people boarding the bus. For routes where you are joining the rout part way and there are people on the bus, person at the front door should count the passengers on the upper deck and the person at the middle door should count the main deck. The each person will enter the number of people they have counted (ie, adding the person at the front and the person at the rears numbers together will total the number of people on the bus). The person at the rear doors (New Routemaster only) should always record 0.
- Click 'Next' to continue.

MAIN BOARDING SCREEN

SCREEN SHOT OF MAIN BOARDING SCREEN

The top of the screen shows the bus stop being observed e.g. 'Deptford Bridge'. If the stop shown is not correct then please amend it using the dropdown list.

- Each surveyor must record when '**wheels stop**' and '**doors open**', by tapping the button on the screen with their stylus. Then the surveyor should record the number of boarders according to whether they are paying with:

Dwell time web service

DEPTFORD BRIDGE [DLR] T ▼

Wheels Stop Bus Continues

Doors Open Doors Don't Open

Contactless	+2	0	-
Pass shown	+2	0	-
No fare presented	+2	0	-
One More Journey	+2	0	-
Alighters	+2	0	-

Doors Close Wheels Move Next

- Smart card (Oyster or other card tapped against the reader)
 - Pass shown (pass simply shown to the driver - includes all paper passes and tickets)
 - smart card rejected (if the person taps their card and there is an error)
 - No fare presented (if someone walks on the bus without paying)
 - One More Journey (For the front door only, the card reader will make a special sound and print a ticket)
 - Alighters
 - If the front door opens **before** the bus has stopped press 'wheels stop' followed immediately by 'doors open'.
 - If you are sitting on the middle or rear door on the New Routemaster bus please code all passengers accordingly as they board.
 - If the bus stops but the doors do not open then press 'Doors don't open'.
- Finally record when the 'doors close' and 'wheels move'.
 - The rear doors on the New Routemaster will remain open when there is a conductor present. When rear is chosen on the initial screen and additional button will be shown that reads 'Doors remain open'. Choose this if the doors are open when the bus stops at a stop. If the doors are open when the bus leaves the stop, do not tap 'doors close'. Tap 'wheels move'.
 - Click 'Next' to continue.

UNUSUAL EVENTS

- A summary of the atypical events and definitions, where appropriate, is shown below. Please use this only when you judge that the buses progress has been significantly delayed. Also enter any additional notes that make this dwell different. If a mistake was made in recoding the dwell (button pressed to early, for example) please also record this here.

Dwell time web service

Select any of the following which occurred at this stop

☐ Wait for Late Boarder

☐ Slow Boarders/alighters – Elderly, Infirm, with Luggage

☐ Footway crowding impeding Boarding/alighting

☐ Bus crowding impeding Boarding/alighting

☐ Obstruction preventing Bus pulling to kerb

☐ Vehicle (inc. other bus) parking in bus stop

☐ Passenger sent to driver from rear

Any other notes:

Next

WHEELCHAIRS & PUSHCHAIRS

- Select how many wheelchair's alighting.
- Select how many wheelchairs boarding.
- Select how many prams boarding.
- Select how many prams alighting.

Dwell time web service

Wheelchair On	0	-
Wheelchair Off	0	-
Pushchair On	0	-
Pushchair Off	0	-

Next

SCREEN SHOT OF DATA ACCURACY SCREEN

Dwell time web service

Are you confident that the data collected at this stop was collected accurately

No Yes

Please indicate if the data was accurately recorded e.g. did you tap the time-based buttons at the right time? Did you record the correct number of boarders, using the correct payment methods? Etc. If you are not confident that the data collected were accurate then please select 'NO'.

BETWEEN STOPS (New Routemaster – Rear door only)

Just before you arrive at the next stop, fill in this page with the number of boarders and alighters

Dwell time web service

Did anyone board or alight between stops?

Boarder	+2	0	-
Alighter	+2	0	-

Next

End of Dwell survey

- When you reach the end of the dwell survey, a screen will prompt you to enter the number of people still on the bus. As with boarding for routes where you alight at the end of the route, enter 0 and ensure you count the number of people alighting the bus at this last stop. For routes where you are alighting the route part way and there are people that remain on the bus, person at the front door should count the passengers on the upper deck and the person at the middle door should count the main deck. Each person will enter the number of people they have counted (ie, adding the person at the front and the person at the rear numbers together will total the number of people on the bus). The person at the rear doors (New Routemaster only) should always record 0.
- You should also verify whether the run was complete from start to finish.
- Finally press the save results button and return you to the initial screen to begin another run.

C Journey Time Survey – Briefing Notes

Introduction

We will be conducting Journey Time surveys on four London Bus routes (53 & 453 and 24 & 29) over 3 days to be scheduled between 19 January and 06 February. The survey is used to assess the difference in journey times between different bus routes.

Bus route 53 and 453 will be surveyed according to the following table (one person for each row of the table):

Location	Area	Routes surveyed at this location	Direction	Description of data to be recorded
<u>Stop B & C</u>	Lambeth North	53 & 453	Start/East	Timing point of 53 & 453 buses mid route.
<u>Stop E</u>	Deptford	53 & 453	East	Timing point of 53 & 453 buses mid route.
<u>Stop F</u>	Deptford	53 & 453	West	Timing point of 53 & 453 buses mid route.
<u>Stop M</u>	Marylebone	453	End	Arrival of buses at end of route 453. Departure of buses at beginning of route 453.

Bus route 24 and 29 will be surveyed according to the following table (one person for each row of the table):

Location	Area	Routes surveyed at this location	Direction	Description of data to be recorded
<u>Stop CM</u>	Pimlico	24	Start/End	Arrival of buses at end of route 24. Departure of buses at beginning of route 24.
<u>Stop C & Stop D</u>	Trafalgar Square	24 & 29	North & South	Timing point of 24 & 29 buses mid route.
<u>Stop J</u>	Camden Town	24 & 29	Northbound	Timing point of 24 & 29 buses mid route.
<u>Stop S</u>	Camden Town	24 & 29	Southbound	Timing point of 24 & 29 buses mid route.
<u>Stop Z & Stop A</u>	Hampstead Heath	24	End/Start	Arrival of buses at end of route 24. Departure of buses at beginning of route 24.
<u>Stop HB</u>	Wood Green	29	End	Arrival of buses at end of route 29.
<u>Stop G</u>	Wood Green	29	Start	Departure of buses at beginning of route 29.

Survey

Surveying will be carried out on 3 weekdays from 7am to 7pm in half day shifts. For each shift you will be allocated a bus stop at which to carry out the survey. The survey schedule will be provided by TDC

As we are timing full bus journeys, it is very important that we have surveyors at each location at all times during the day.

In addition to your allocated bus stop, you will be also be allocated one or two of the above bus routes. You will then be recording the arrival and departure times of your allocated buses at your allocated stop. This information will be used to determine the overall journey times on the bus route. This important information will help in determining the future bus services that people receive, so please record carefully. Journeys will be matched based on the number plate so it is very important to record this as accurately as possible.

Journey Time data will be recorded on paper booklets and location will have its own collection sheet.

D Example of Journey Time Data Collection Sheets

Surveyor Name:	
Route:	24
Direction:	Start/End
Location (Stop Name):	Bus stop CM 'Grosvenor Road'
Recording	Arrivals/Departures
Date:	
Current Time:	
Weather:	
Sheet Number (1,2,3,etc):	

BUS REGISTRATION NUMBER (record whole of registration number)	TIMES			COMMENTS (e.g. observations of very heavy traffic in the direction of buses you are recording / very bad weather / very congested bus / bus obstructed from pulling in / unusual type of bus etc...)
	<i>Arrival</i>	<i>Departure</i>	<i>Bus didn't stop</i>	
	(time wheels stop at bus stop) <i>hh:mm:ss</i>	(time bus wheels move leaving bus stop) <i>hh:mm:ss</i>	(if bus just passed through - time it passed the stop) <i>hh:mm:ss</i>	

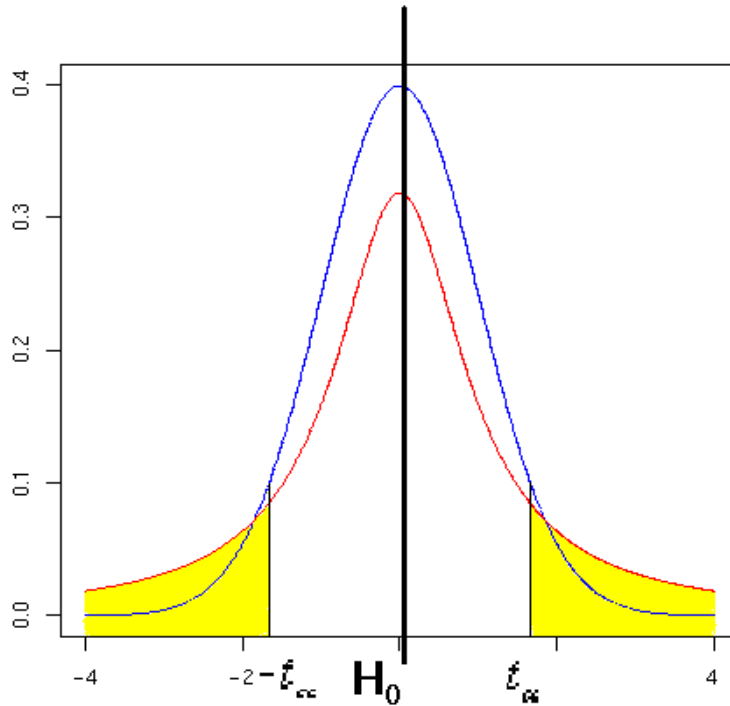
E Students T-distribution

Student's T-Distribution

- E.1 The T statistic is used to test the validity of the Null Hypothesis H_0 , which in our analysis is probability that our marginal activity parameters and fixed stop time constants from our activity regression models are statistically significant or statistically significant from another 'null' value. The T statistic is calculated as follows:

$$T = \frac{\bar{X} - u_0}{\sqrt{S^2 / n}}$$

- E.2 Where $\bar{X}$ is an estimator of the mean value of our calculated result based upon the sample data, and where u_0 is the null value to which we want to test our estimator against, which in the case of a regression model is equal to zero (statistically insignificant). S^2 is the variance of our sample data and n is equal to the number of observations.
- E.3 We are using Student's t distribution in order to infer whether our calculated T Statistic is statistically different from the Null Hypothesis H_0 . The t distribution is wider than a normal "bell-shaped" distribution given that the true variance of our data is unknown and therefore explaining our use of the estimator S^2 instead. Figure 6.9 shows the student's t distribution.



- E.4 Next, we arrive at the critical value t_{α} for a given level of significance α , for a 95% level of significance we set α to 0.025 for a two-tailed test. This means that the area shaded under the probability distribution curve in figure 6.9 sums to 5%. Using this condition, if the following equation holds:

$$T = \frac{\bar{X} - u_0}{\sqrt{S^2 / n}} > |t_{\alpha}|$$

- E.5 Then we can reject the Null Hypothesis at a 95% level of significance. Note that a t distribution implies that a greater absolute $|t_{\alpha}|$ is needed to reject the same null hypothesis using a t distribution compared to a normal “bell-shaped” distribution because of the added uncertainty around estimating the variance. For our analysis, the critical value t_{α} is 1.96.
- E.6 To confirm that the average dwell time per stop is higher for the 453 than the 53 and that the average dwell time per stop is higher for the 24 than the 29, the data for each pair of routes have been compared in a statistical hypothesis test to assure us that the observed differences are unlikely to be due to random variation. We use the notation H_0 to indicate the null hypothesis, that the average dwell times are the same; and H_A to indicate the alternative hypothesis that the averages are significantly different.
- H_0 : average dwell time (53) = average dwell time (453)
- H_A : average dwell time (53) $\neq$ average dwell time (453)
- H_0 : average dwell time (24) = average dwell time (29)
- H_A : average dwell time (24) $\neq$ average dwell time (29)

- E.7 Table 5.2 shows the results of the hypothesis test comparing the mean dwell times of the two pairs of routes. The hypothesis test uses a t-test to calculate whether the comparator have statistically different dwell times. A t-statistic greater than 1.96 implies that they have statistically different dwell times.

Alternative hypothesis	p-value	Decision
453 > 53	0.000	Do not reject
453 < 53	1.000	Reject
24 > 29	0.049	Do not reject
24 < 29	0.951	Reject

- E.8 In both cases the results of the statistical test are that we can be 95% confident that the differences in dwell times are not due to random variation. The average dwell time per stop is higher for the 453 than the 53 and the average dwell time per stop is higher for the 24 than the 29.

F Stop to Stop Journey Times and Average Activities

Table F.1 Stop to Stop Journey Times and Average Activities, 53 towards Whitehall

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
FLORENCE ROAD	21	01:33	01:54	6
NEW CROSS STATION #	19	00:34	00:59	4
MARQUIS OF GRANBY / GOLDSMITHS	21	02:00	02:18	5
NEW CROSS GATE STATION #	24	00:54	01:15	8
NEW CROSS BUS GARAGE	25	01:05	01:31	11
NEW CROSS ROAD / BESSON STREET	16	01:16	01:43	4
BRIANT STREET	12	00:35	00:54	3
POMEROY STREET	15	00:47	00:59	3
OLD KENT ROAD / ILBERTON ROAD	22	01:08	01:23	6
COMMERCIAL WAY	18	00:37	01:00	4
PECKHAM PARK ROAD	20	01:11	01:31	6
MALT STREET	23	02:17	02:39	7
TRAFALGAR AVENUE	18	00:48	01:10	5
DUNTON ROAD	26	01:36	01:55	8
OLD KENT ROAD / EAST STREET	21	01:25	01:52	5
BRICKLAYER'S ARMS	16	00:42	01:04	3
BRICKLAYER'S ARMS / NEW KENT ROAD	18	00:49	01:05	3
RODNEY PLACE	13	00:59	01:16	2
ELEPHANT & CASTLE / NEW KENT ROAD	33	00:42	00:55	17
LONDON COLLEGE OF COMMUNICATION	21	01:15	01:48	8
ST GEORGE'S ROAD / IMPERIAL WAR MUSEUM	14	00:50	01:14	3

Table F.2 Stop to Stop Journey Times and Average Activities, 53 Towards Deptford

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
ST GEORGE'S CIRCUS	14	00:56	01:14	2
ELEPHANT & CASTLE / LONDON ROAD	32	02:06	02:18	11
ELEPHANT & CASTLE / NEW KENT ROAD	28	01:26	01:59	9
RODNEY PLACE	15	00:46	01:17	3
BRICKLAYER'S ARMS / NEW KENT ROAD	17	01:01	01:18	3
BRICKLAYER'S ARMS	16	02:00	02:16	3
OLD KENT ROAD / EAST STREET	19	00:36	00:52	5
DUNTON ROAD	28	01:51	02:08	9
TRAFALGAR AVENUE	16	01:37	02:06	3
MALT STREET	18	00:45	01:00	5
PECKHAM PARK ROAD	17	01:49	02:07	4
COMMERCIAL WAY	15	00:45	01:00	2
OLD KENT ROAD / ILBERTON ROAD	21	01:03	01:17	7
BRIANT STREET	19	03:28	03:48	4
NEW CROSS BUS GARAGE	32	02:15	02:33	11
NEW CROSS GATE STATION #	26	01:48	02:19	7
MARQUIS OF GRANBY	21	01:25	01:49	6
NEW CROSS STATION #	19	00:56	01:17	3
DEPTFORD HIGH STREET	23	02:05	02:24	7

Table F.3 Stop to Stop Journey Times and Average Activities, 453 Towards Whitehall

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
FLORENCE ROAD	19	01:31	01:40	8
NEW CROSS STATION #	19	00:37	00:54	5
MARQUIS OF GRANBY / GOLDSMITHS	19	01:45	02:04	8
NEW CROSS GATE STATION #	28	00:58	01:17	11
NEW CROSS BUS GARAGE	23	01:05	01:33	10
NEW CROSS ROAD / BESSON STREET	22	01:08	01:32	6
BRIANT STREET	17	00:38	01:00	5
POMEROY STREET	20	00:46	01:05	6
OLD KENT ROAD / ILDERTON ROAD	24	01:08	01:28	8
COMMERCIAL WAY	20	00:38	01:02	5
PECKHAM PARK ROAD	24	01:14	01:33	8
MALT STREET	26	01:47	02:13	9
TRAFALGAR AVENUE	26	00:50	01:15	6
DUNTON ROAD	33	01:54	02:19	13
OLD KENT ROAD / EAST STREET	23	01:33	02:04	6
BRICKLAYER'S ARMS	22	00:44	01:07	4
BRICKLAYER'S ARMS / NEW KENT ROAD	20	00:54	01:16	4
RODNEY PLACE	15	01:03	01:21	2
ELEPHANT & CASTLE / NEW KENT ROAD	32	00:47	01:01	18
LONDON COLLEGE OF COMMUNICATION	27	01:05	01:37	9
ST GEORGE'S ROAD / IMPERIAL WAR MUSEUM	17	00:51	01:17	6
LAMBETH NORTH STATION <>	18	01:30	01:47	3
LOWER MARSH	24	01:11	01:28	3
ST THOMAS' HOSPITAL / COUNTY HALL	27	02:20	02:39	10
WESTMINSTER STATION<> / PARLIAMENT SQUARE	23	02:17	02:45	5
HORSE GUARDS PARADE	14	00:48	01:10	2
TRAFALGAR SQUARE	21	03:52	04:08	8
REGENT STREET / ST JAMES'S	23	02:15	02:35	7
PICCADILLY CIRCUS	22	01:58	02:23	4
CONDUIT STREET / HAMLEYS TOY STORE	15	02:00	02:19	4
MARGARET STREET / OXFORD CIRCUS	26	03:06	03:21	10
PORTLAND PLACE	16	02:43	03:08	3
GREAT PORTLAND STREET STATION <>	14	03:32	03:47	2
REGENT'S PARK STATION <>	13	02:03	02:15	1
HARLEY STREET	13	01:01	01:13	2
BAKER STREET STATION <>	16	01:56	02:08	4
GLOUCESTER PLACE	21	00:50	01:03	2

Table F.4 Stop to Stop Journey Times and Average Activities, 453 Towards Whitehall

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
BAKER STREET	8	01:12	01:17	1
BAKER STREET STATION <>	20	00:17	00:24	4
HARLEY STREET	14	01:27	01:45	1
REGENT'S PARK STATION <>	15	01:01	01:17	2
GREAT PORTLAND STREET STATION <>	17	02:38	02:54	4
NEW CAVENDISH STREET	18	01:19	01:34	3
OXFORD CIRCUS STATION <> / MARGARET STREET	26	04:41	05:00	7
CONDUIT STREET / HAMLEYS TOY STORE	19	02:59	03:26	3
PICCADILLY CIRCUS	29	02:47	03:07	4
HAYMARKET	24	03:11	03:41	2
TRAFALGAR SQUARE / CHARING CROSS STN <> #	25	01:35	02:00	4
WHITEHALL / HORSEGUARDS AVENUE	28	02:53	03:12	4
HORSE GUARDS PARADE	20	01:05	01:19	2
WESTMINSTER STATION <> / PARLIAMENT SQUARE	20	00:41	00:57	4
ST THOMAS' HOSPITAL / COUNTY HALL	27	02:28	02:46	8
LOWER MARSH	19	01:24	01:52	3
LAMBETH NORTH STATION <>	21	01:11	01:29	4
ST GEORGE'S CIRCUS	16	01:09	01:31	2
ELEPHANT & CASTLE / LONDON ROAD	34	02:09	02:26	14
ELEPHANT & CASTLE / NEW KENT ROAD	28	01:28	02:04	9
RODNEY PLACE	14	00:48	01:17	2
BRICKLAYER'S ARMS / NEW KENT ROAD	15	01:04	01:17	3
BRICKLAYER'S ARMS	18	01:53	02:08	3
OLD KENT ROAD / EAST STREET	24	00:39	00:58	5
DUNTON ROAD	27	01:41	02:01	14
TRAFALGAR AVENUE	17	01:29	01:55	3
MALT STREET	20	00:40	00:58	7
PECKHAM PARK ROAD	21	01:57	02:19	6
COMMERCIAL WAY	17	00:43	01:04	4
OLD KENT ROAD / ILDETON ROAD	21	01:06	01:24	8
BRIANT STREET	19	02:20	02:41	6
NEW CROSS BUS GARAGE	26	01:39	01:59	11
NEW CROSS GATE STATION #	22	01:45	02:12	7
MARQUIS OF GRANBY	23	01:26	01:49	7
NEW CROSS STATION #	17	01:02	01:28	3
DEPTFORD HIGH STREET	18	01:38	01:54	7

Table F.5 Stop to Stop Journey Times and Average Activities, 24 Towards Camden

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
LEICESTER SQUARE STATION <>	21	01:15	01:40	6
CAMBRIDGE CIRCUS	22	01:03	01:25	6
DENMARK STREET	23	02:01	02:25	6
TOTTENHAM COURT ROAD STATION<>	21	04:09	04:32	8
PERCY STREET	15	00:52	01:14	4
GOODGE STREET STATION <>	21	01:32	01:47	5
WARREN STREET STATION <>	28	02:36	02:57	9
HAMPSTEAD ROAD / DRUMMOND STREET	20	01:28	01:57	5
ROBERT STREET	17	00:51	01:10	3
SILVERDALE	15	01:03	01:22	3
MORNINGTON CRESCENT STATION <>	19	01:06	01:21	4
CAMDEN HIGH STREET	26	01:11	01:30	8

Table F.6 Stop to Stop Journey Times and Average Activities, 24 Towards Trafalgar Square

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
PRATT STREET	20	01:11	01:40	7
MORNINGTON CRESCENT STATION <>	19	01:50	02:11	5
SILVERDALE	15	01:22	01:42	2
ROBERT STREET	16	00:41	00:58	3
WARREN STREET STATION <> / EUSTON ROAD	25	01:11	01:27	9
GOWER STREET / UNIVERSITY COLLEGE HOSP	20	02:04	02:28	7
TORRINGTON PLACE	16	00:34	00:56	5
CHENIES STREET	16	01:09	01:26	4
GREAT RUSSELL STREET	19	01:18	01:34	6
TOTTENHAM COURT ROAD STATION <>	18	03:15	03:36	5
CAMBRIDGE CIRCUS	25	02:45	03:05	6
LEICESTER SQUARE STATION <>	24	01:14	01:38	7
ST MARTIN'S PLACE	19	00:58	01:22	3
TRAFALGAR SQUARE / CHARING CROSS STN <>#	24	02:12	02:32	5

Table F.7 Stop to Stop Journey Times and Average Activities, 29 Towards Trafalgar Square

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
PRATT STREET	18	01:07	01:34	6
MORNINGTON CRESCENT STATION <>	16	01:41	01:58	4
SILVERDALE	13	01:16	01:31	2
ROBERT STREET	12	00:40	00:52	3
WARREN STREET STATION <> / EUSTON ROAD	24	01:07	01:18	11
GOWER STREET / UNIVERSITY COLLEGE HOSP	19	02:17	02:43	7
TORRINGTON PLACE	12	00:35	00:54	4
CHENIES STREET	13	01:02	01:14	4
GREAT RUSSELL STREET	15	01:18	01:31	5
TOTTENHAM COURT ROAD STATION <>	15	03:36	03:51	5
CAMBRIDGE CIRCUS	15	02:58	03:13	4
LEICESTER SQUARE STATION <>	15	01:07	01:22	5
ST MARTIN'S PLACE	13	00:59	01:13	2

Table F.8 Stop to Stop Journey Times and Average Activities, 29 Towards Camden

Stop Name	Average Dwell Time (sec)	Average Journey Time To Stop (mm:ss)	Average Observed Stop to Stop Journey Time (mm:ss)	Average Activities
LEICESTER SQUARE STATION <>	17	00:52	01:03	4
CAMBRIDGE CIRCUS	15	01:06	01:23	3
DENMARK STREET	18	02:21	02:37	4
TOTTENHAM COURT ROAD STATION<>	21	03:35	03:52	7
PERCY STREET	14	00:46	01:09	3
GOODGE STREET STATION <>	19	01:20	01:35	5
WARREN STREET STATION <>	24	02:26	02:42	8
HAMPSTEAD ROAD / DRUMMOND STREET	23	01:25	01:50	7
ROBERT STREET	15	00:54	01:19	3
SILVERDALE	16	01:00	01:14	3
MORNINGTON CRESCENT STATION <>	15	00:58	01:14	4
CAMDEN HIGH STREET	19	01:10	01:24	6

G 2008 Marginal Activity Time

Table G.1: 2008 Model 1 Results

		53	453
Fixed stop constant (sec)	Coefficient	9.8	11.9
	Standard error	0.37	0.35
	t-stat	26.7	34.5
Marginal activity time (sec)	Coefficient	1.3	0.6
	Standard error	0.04	0.03
	t-stat	30.6	19.6
Adjusted R squared		0.53	0.35

Table G.2: 2008 Model 2 Results

		53	453
Fixed stop constant (sec)	Coefficient	9.6	11.4
	Standard error	0.35	0.3
	t-stat	27.7	33.4
Marginal boarding time (sec)	Coefficient	1.6	0.8
	Standard error	0.06	0.05
	t-stat	25.7	16.2
Marginal alighting time (sec)	Coefficient	1.0	0.4
	Standard error	0.05	0.04
	t-stat	18.2	11.8
Adjusted R squared		0.56	0.36

H Dwell time model data

Table H.1: Dwell Times by Route and Number of Activities (Routes 53 and 453)

Number of activities	Fixed stop time (sec)		Total boarding and alighting time		Dwell time (sec)		Diff (sec)
	Route 53	Route 453	Route 53	Route 453	Route 53	Route 453	
1	12.5	15.3	1.4	1.0	13.9	16.2	-2.3
2	12.5	15.3	2.9	1.9	15.4	17.2	-1.8
3	12.5	15.3	4.3	2.9	16.8	18.2	-1.4
4	12.5	15.3	5.7	3.9	18.2	19.1	-0.9
5	12.5	15.3	7.2	4.8	19.7	20.1	-0.4
6	12.5	15.3	8.6	5.8	21.1	21.1	0.0
7	12.5	15.3	10.0	6.8	22.5	22.0	0.5
8	12.5	15.3	11.5	7.7	24.0	23.0	1.0
9	12.5	15.3	12.9	8.7	25.4	24.0	1.4
10	12.5	15.3	14.3	9.7	26.8	24.9	1.9
11	12.5	15.3	15.8	10.6	28.3	25.9	2.3
12	12.5	15.3	17.2	11.6	29.7	26.9	2.8
13	12.5	15.3	18.6	12.6	31.1	27.8	3.3
14	12.5	15.3	20.1	13.6	32.6	28.8	3.7
15	12.5	15.3	21.5	14.5	34.0	29.8	4.2
16	12.5	15.3	22.9	15.5	35.4	30.8	4.7
17	12.5	15.3	24.4	16.5	36.9	31.7	5.1
18	12.5	15.3	25.8	17.4	38.3	32.7	5.6
19	12.5	15.3	27.2	18.4	39.7	33.7	6.1
20	12.5	15.3	28.7	19.4	41.2	34.6	6.5
21	12.5	15.3	30.1	20.3	42.6	35.6	7.0
22	12.5	15.3	31.5	21.3	44.0	36.6	7.5
23	12.5	15.3	33.0	22.3	45.5	37.5	7.9
24	12.5	15.3	34.4	23.2	46.9	38.5	8.4
25	12.5	15.3	35.8	24.2	48.3	39.5	8.9
26	12.5	15.3	37.3	25.2	49.8	40.4	9.3
27	12.5	15.3	38.7	26.1	51.2	41.4	9.8
28	12.5	15.3	40.1	27.1	52.6	42.4	10.2
29	12.5	15.3	41.6	28.1	54.1	43.3	10.7
30	12.5	15.3	43.0	29.0	55.5	44.3	11.2
31	12.5	15.3	44.4	30.0	56.9	45.3	11.6
32	12.5	15.3	45.9	31.0	58.4	46.2	12.1
33	12.5	15.3	47.3	31.9	59.8	47.2	12.6
34	12.5	15.3	48.7	32.9	61.2	48.2	13.0
35	12.5	15.3	50.2	33.9	62.6	49.1	13.5
36	12.5	15.3	51.6	34.8	64.1	50.1	14.0
37	12.5	15.3	53.0	35.8	65.5	51.1	14.4
38	12.5	15.3	54.5	36.8	66.9	52.0	14.9
39	12.5	15.3	55.9	37.8	68.4	53.0	15.4
40	12.5	15.3	57.3	38.7	69.8	54.0	15.8

Table H.2: Dwell Times by Route and Number of Activities (Routes 24 and 29)

Number of activities	Fixed stop time (sec)		Total boarding and alighting time		Dwell time (sec)		Diff (sec)
	Route 24	Route 29	Route 24	Route 29	Route 24	Route 29	
1	14.4	9.5	1.1	1.5	15.5	11.0	4.4
2	14.4	9.5	2.2	3.0	16.5	12.5	4.0
3	14.4	9.5	3.2	4.5	17.6	14.0	3.6
4	14.4	9.5	4.3	6.0	18.7	15.5	3.2
5	14.4	9.5	5.4	7.5	19.8	17.0	2.8
6	14.4	9.5	6.5	9.0	20.9	18.5	2.4
7	14.4	9.5	7.6	10.5	22.0	20.0	1.9
8	14.4	9.5	8.7	12.0	23.0	21.5	1.5
9	14.4	9.5	9.7	13.5	24.1	23.0	1.1
10	14.4	9.5	10.8	15.0	25.2	24.5	0.7
11	14.4	9.5	11.9	16.5	26.3	26.0	0.3
12	14.4	9.5	13.0	18.0	27.4	27.5	-0.1
13	14.4	9.5	14.1	19.5	28.5	29.0	-0.5
14	14.4	9.5	15.2	21.0	29.5	30.5	-1.0
15	14.4	9.5	16.2	22.5	30.6	32.0	-1.4
16	14.4	9.5	17.3	24.0	31.7	33.5	-1.8
17	14.4	9.5	18.4	25.5	32.8	35.0	-2.2
18	14.4	9.5	19.5	27.0	33.9	36.5	-2.6
19	14.4	9.5	20.6	28.5	35.0	38.0	-3.0
20	14.4	9.5	21.7	30.0	36.0	39.5	-3.5
21	14.4	9.5	22.7	31.5	37.1	41.0	-3.9
22	14.4	9.5	23.8	33.0	38.2	42.5	-4.3
23	14.4	9.5	24.9	34.5	39.3	44.0	-4.7
24	14.4	9.5	26.0	36.0	40.4	45.5	-5.1
25	14.4	9.5	27.1	37.5	41.5	47.0	-5.5
26	14.4	9.5	28.2	39.0	42.5	48.5	-5.9
27	14.4	9.5	29.2	40.5	43.6	50.0	-6.4
28	14.4	9.5	30.3	42.0	44.7	51.5	-6.8
29	14.4	9.5	31.4	43.4	45.8	53.0	-7.2
30	14.4	9.5	32.5	44.9	46.9	54.5	-7.6
31	14.4	9.5	33.6	46.4	48.0	56.0	-8.0
32	14.4	9.5	34.7	47.9	49.0	57.5	-8.4
33	14.4	9.5	35.7	49.4	50.1	59.0	-8.9
34	14.4	9.5	36.8	50.9	51.2	60.5	-9.3
35	14.4	9.5	37.9	52.4	52.3	62.0	-9.7
36	14.4	9.5	39.0	53.9	53.4	63.5	-10.1
37	14.4	9.5	40.1	55.4	54.5	65.0	-10.5
38	14.4	9.5	41.2	56.9	55.5	66.5	-10.9
39	14.4	9.5	42.2	58.4	56.6	68.0	-11.3
40	14.4	9.5	43.3	59.9	57.7	69.5	-11.8

I 2003,2008 and 2015 Comparative Dwell Time Data

Table I.1: Comparative Dwell Time Statistics by Year, Route and Stop, Route 53 Towards Deptford

	Average Dwell Time (sec)				Average Number of Boarding/Alighting Passengers				Average Boarding/Alighting Time per Passenger (sec)			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Lambeth North Station												
St George's Circus	11.3	9.7	13.6	40%	2.2	2.4	2.1	-12%	5.2	4	6.4	61%
Elephant & Castle, London Rd	42.4	31.5	31.9	1%	22	15.2	10.9	-28%	1.9	2.1	2.9	39%
Elephant & Castle, New Kent Road	27.6	24.3	28.0	15%	10.5	8.3	9.2	11%	2.6	2.9	3.1	5%
Rodney Place	11.1	9.5	14.5	53%	2.9	1.9	2.9	52%	3.9	5	5.0	0%
Tower Bridge Road, Bartholemew Street	16.1	10	17.3	73%	4.1	2.3	2.8	20%	4	4.4	6.3	43%
Bricklayers Arms	12.3	13.4	16.3	21%	3.5	3.4	2.9	-15%	3.5	4	5.6	40%
Old Kent Road, East Street	15.2	14.8	18.6	26%	4.7	4.8	4.7	-3%	3.2	3	4.0	33%
Dunton Road	20.4	23.3	28.3	22%	8.8	11.2	9.2	-18%	2.3	2.1	3.1	47%
Trafalgar Avenue	10.8	11.4	16.0	40%	3.2	3.3	2.8	-15%	3.4	3.5	5.7	62%
Malt Street	10.5	17.6	17.7	0%	2.8	7.1	4.6	-35%	3.8	2.5	3.8	53%
Peckham Park Road	14.1	12.8	17.4	36%	5.6	5	3.8	-24%	2.5	2.6	4.6	75%
Commercial Way, Old Kent Road	13.2	14.6	15.2	4%	2.9	5.2	2.3	-55%	4.6	2.8	6.5	131%
Old Kent Road, Ilderton Road	13.4	16.8	21.4	28%	4.6	5.1	6.6	29%	2.9	3.3	3.3	-1%
Kender Street	11.5	10.8	18.5	72%	3.6	3	3.7	24%	3.2	3.6	5.0	38%
New Cross Bus Garage	29.6	35.7	32.2	-10%	12.9	17.4	10.8	-38%	2.3	2.1	3.0	42%
New Cross Gate Station	22.9	20.4	25.6	26%	8.2	7.6	7.5	-1%	2.8	2.7	3.4	27%
Marquis of Granby	18.3	15.7	21.2	35%	7	4.5	6.1	35%	2.6	3.5	3.5	0%
New Cross Station	14.1	13.6	18.6	37%	3.1	3.3	3.3	-1%	4.6	4.1	5.7	39%
Deptford High Street, New Cross Road	19.2	21	23.4	11%	8.3	7.9	7.1	-10%	2.3	2.6	3.3	27%
Deptford Bridge												

Table I.2: Comparative Dwell Time Statistics by Year, Route and Stop, Route 453 Towards Deptford

	Average Dwell Time (sec)				Average Number of Boarding/Alighting Passengers				Average Boarding/Alighting Time per Passenger (sec)			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Marylebone, Great Central Street												
Baker Street, Gloucester Place	18.3	23.2	8.1	-65%	4.6	8	0.7	-92%	4	2.9	12.2	320%
Baker Street Station	-	-	19.9	-	-	-	4.0	-	-	-	5.0	-
Harley Street	12.1	14.7	13.7	-7%	2.8	5.7	1.5	-74%	4.4	2.6	9.3	257%
Regent's Park Station	10.3	12.3	15.4	25%	3	4.2	1.8	-57%	3.4	2.9	8.6	195%
Great Portland Street Station	15.6	17.8	16.5	-7%	7.2	4.7	4.4	-7%	2.2	3.8	3.8	0%
New Cavendish Street	8.9	16	17.6	10%	3	4.3	3.4	-21%	3	3.7	5.2	40%
Oxford Circus Station	16.2	18.4	26.4	43%	9.5	11.4	6.7	-41%	1.7	1.6	3.9	146%
Conduit Street	14.6	15.5	18.9	22%	5.5	4.8	2.8	-42%	2.7	3.2	6.9	114%
Piccadilly Circus	15.1	19.7	28.5	45%	5.3	10.3	4.1	-60%	2.9	1.9	6.9	265%
Haymarket	12.9	14.7	24.4	66%	5.4	4.9	2.4	-50%	2.4	3	10.0	233%
Trafalgar Square, Charing X Station	16.6	21.5	24.7	15%	6.1	4.4	3.9	-11%	2.7	4.9	6.3	28%
Whitehall, Trafalgar Square	13.8	19.1	28.2	48%	4.9	6.6	4.0	-39%	2.8	2.9	7.1	143%
Horse Guards Parade	7.8	12.9	20.2	56%	1.7	1	2.0	100%	4.7	12.9	10.1	-22%
Parliament Square	14.9	13.4	20.3	51%	5.4	4	4.3	6%	2.7	3.4	4.8	40%
County Hall, Westminster Bridge	17.3	22.4	27.0	21%	5.7	7.7	7.9	3%	3.1	2.9	3.4	17%
Lower Marsh, Carlisle Road	10.7	11.3	19.3	71%	2.9	3.2	2.6	-19%	3.8	3.5	7.5	114%
Lambeth North Station	12.8	13.1	20.5	56%	3.5	4.2	3.5	-17%	3.7	3.1	5.9	89%
St George's Circus	10.9	10.5	15.8	51%	2.3	1.9	2.3	18%	4.7	5.6	7.0	25%
Elephant & Castle, London Rd	25.9	34.3	33.6	-2%	20.2	20.5	14.2	-31%	1.3	1.7	2.4	39%
Elephant & Castle, New Kent Road	18.3	21.6	27.5	27%	7.9	14.8	8.5	-42%	2.3	1.5	3.2	115%
Rodney Place	13.1	11.4	13.6	20%	3.3	2.9	2.3	-22%	4	4	6.0	51%
Tower Bridge Road, Bartholemew Street	11.2	13.8	15.3	11%	3.2	4.1	2.9	-30%	3.5	3.4	5.4	58%
Bricklayers Arms	12.3	15.7	17.8	13%	3.7	4.8	3.0	-38%	3.3	3.2	5.9	85%
Old Kent Road, East Street	13	14.3	23.5	64%	4.8	5.4	4.6	-14%	2.7	2.6	5.1	94%
Dunton Road	19.9	21	27.1	29%	12.6	18.2	14.4	-21%	1.6	1.2	1.9	57%
Trafalgar Avenue	12.6	14.7	17.2	17%	3.8	6.1	3.1	-49%	3.4	2.4	5.6	132%

	Average Dwell Time (sec)				Average Number of Boarding/Alighting Passengers				Average Boarding/Alighting Time per Passenger (sec)			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Marylebone, Great Central Street												
Baker Street, Gloucester Place	18.3	23.2	8.1	-65%	4.6	8	0.7	-92%	4	2.9	12.2	320%
Baker Street Station	-	-	19.9	-	-	-	4.0	-	-	-	5.0	-
Harley Street	12.1	14.7	13.7	-7%	2.8	5.7	1.5	-74%	4.4	2.6	9.3	257%
Regent's Park Station	10.3	12.3	15.4	25%	3	4.2	1.8	-57%	3.4	2.9	8.6	195%
Great Portland Street Station	15.6	17.8	16.5	-7%	7.2	4.7	4.4	-7%	2.2	3.8	3.8	0%
New Cavendish Street	8.9	16	17.6	10%	3	4.3	3.4	-21%	3	3.7	5.2	40%
Oxford Circus Station	16.2	18.4	26.4	43%	9.5	11.4	6.7	-41%	1.7	1.6	3.9	146%
Conduit Street	14.6	15.5	18.9	22%	5.5	4.8	2.8	-42%	2.7	3.2	6.9	114%
Piccadilly Circus	15.1	19.7	28.5	45%	5.3	10.3	4.1	-60%	2.9	1.9	6.9	265%
Haymarket	12.9	14.7	24.4	66%	5.4	4.9	2.4	-50%	2.4	3	10.0	233%
Trafalgar Square, Charing X Station	16.6	21.5	24.7	15%	6.1	4.4	3.9	-11%	2.7	4.9	6.3	28%
Whitehall, Trafalgar Square	13.8	19.1	28.2	48%	4.9	6.6	4.0	-39%	2.8	2.9	7.1	143%
Horse Guards Parade	7.8	12.9	20.2	56%	1.7	1	2.0	100%	4.7	12.9	10.1	-22%
Parliament Square	14.9	13.4	20.3	51%	5.4	4	4.3	6%	2.7	3.4	4.8	40%
County Hall, Westminster Bridge	17.3	22.4	27.0	21%	5.7	7.7	7.9	3%	3.1	2.9	3.4	17%
Lower Marsh, Carlisle Road	10.7	11.3	19.3	71%	2.9	3.2	2.6	-19%	3.8	3.5	7.5	114%
Lambeth North Station	12.8	13.1	20.5	56%	3.5	4.2	3.5	-17%	3.7	3.1	5.9	89%
St George's Circus	10.9	10.5	15.8	51%	2.3	1.9	2.3	18%	4.7	5.6	7.0	25%
Elephant & Castle, London Rd	25.9	34.3	33.6	-2%	20.2	20.5	14.2	-31%	1.3	1.7	2.4	39%
Elephant & Castle, New Kent Road	18.3	21.6	27.5	27%	7.9	14.8	8.5	-42%	2.3	1.5	3.2	115%
Rodney Place	13.1	11.4	13.6	20%	3.3	2.9	2.3	-22%	4	4	6.0	51%
Tower Bridge Road, Bartholemew Street	11.2	13.8	15.3	11%	3.2	4.1	2.9	-30%	3.5	3.4	5.4	58%
Malt Street	12.4	20.9	20.4	-2%	4.1	11.1	7.2	-36%	3	1.9	2.9	50%
Peckham Park Road	11.3	17.7	20.5	16%	3.6	10.3	6.0	-41%	3.1	1.7	3.4	99%
Commercial Way, Old Kent Road	11.1	16.2	16.9	4%	3.7	8.6	4.3	-50%	3	1.9	3.9	107%
Old Kent Road, Ilderton Road	15.2	16	20.9	31%	5.6	8.7	8.2	-5%	2.7	1.8	2.5	41%
Kender Street	10.5	14	19.1	36%	2.6	6.3	5.5	-13%	4.1	2.2	3.5	58%
New Cross Bus Garage	20.1	26.4	25.9	-2%	12.8	22	10.6	-52%	1.6	1.2	2.4	104%

	Average Dwell Time (sec)				Average Number of Boarding/Alighting Passengers				Average Boarding/Alighting Time per Passenger (sec)			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Marylebone, Great Central Street												
Baker Street, Gloucester Place	18.3	23.2	8.1	-65%	4.6	8	0.7	-92%	4	2.9	12.2	320%
Baker Street Station	-	-	19.9		-	-	4.0		-	-	5.0	
Harley Street	12.1	14.7	13.7	-7%	2.8	5.7	1.5	-74%	4.4	2.6	9.3	257%
Regent's Park Station	10.3	12.3	15.4	25%	3	4.2	1.8	-57%	3.4	2.9	8.6	195%
Great Portland Street Station	15.6	17.8	16.5	-7%	7.2	4.7	4.4	-7%	2.2	3.8	3.8	0%
New Cavendish Street	8.9	16	17.6	10%	3	4.3	3.4	-21%	3	3.7	5.2	40%
Oxford Circus Station	16.2	18.4	26.4	43%	9.5	11.4	6.7	-41%	1.7	1.6	3.9	146%
Conduit Street	14.6	15.5	18.9	22%	5.5	4.8	2.8	-42%	2.7	3.2	6.9	114%
Piccadilly Circus	15.1	19.7	28.5	45%	5.3	10.3	4.1	-60%	2.9	1.9	6.9	265%
Haymarket	12.9	14.7	24.4	66%	5.4	4.9	2.4	-50%	2.4	3	10.0	233%
Trafalgar Square, Charing X Station	16.6	21.5	24.7	15%	6.1	4.4	3.9	-11%	2.7	4.9	6.3	28%
Whitehall, Trafalgar Square	13.8	19.1	28.2	48%	4.9	6.6	4.0	-39%	2.8	2.9	7.1	143%
Horse Guards Parade	7.8	12.9	20.2	56%	1.7	1	2.0	100%	4.7	12.9	10.1	-22%
Parliament Square	14.9	13.4	20.3	51%	5.4	4	4.3	6%	2.7	3.4	4.8	40%
County Hall, Westminster Bridge	17.3	22.4	27.0	21%	5.7	7.7	7.9	3%	3.1	2.9	3.4	17%
Lower Marsh, Carlisle Road	10.7	11.3	19.3	71%	2.9	3.2	2.6	-19%	3.8	3.5	7.5	114%
Lambeth North Station	12.8	13.1	20.5	56%	3.5	4.2	3.5	-17%	3.7	3.1	5.9	89%
St George's Circus	10.9	10.5	15.8	51%	2.3	1.9	2.3	18%	4.7	5.6	7.0	25%
Elephant & Castle, London Rd	25.9	34.3	33.6	-2%	20.2	20.5	14.2	-31%	1.3	1.7	2.4	39%
Elephant & Castle, New Kent Road	18.3	21.6	27.5	27%	7.9	14.8	8.5	-42%	2.3	1.5	3.2	115%
Rodney Place	13.1	11.4	13.6	20%	3.3	2.9	2.3	-22%	4	4	6.0	51%
Tower Bridge Road, Bartholemew Street	11.2	13.8	15.3	11%	3.2	4.1	2.9	-30%	3.5	3.4	5.4	58%
New Cross Gate Station	13.2	19.1	22.4	18%	3.4	15.4	6.5	-58%	3.9	1.2	3.5	188%
Marquis of Granby	13.6	17.7	23.0	30%	3	9.5	6.6	-31%	4.5	1.9	3.5	84%
New Cross Station	12.2	15.1	16.7	11%	3.4	6.9	3.1	-55%	3.6	2.2	5.4	144%
Deptford High Street, New Cross Road	21	20	17.5	-12%	14.2	18.5	6.6	-64%	1.5	1.1	2.7	142%
Deptford Bridge												

Table I.3: Comparative Dwell Time Statistics by Year, Route and Stop, Route 53 Towards Whitehall

	Average Dwell Time (sec)				Average Number of Boarding/Alighting Passengers				Average Boarding/Alighting Time per Passenger (sec)			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Florence Road	26.1	24.4	21.2	-13%	7.3	8.3	6.1	-27%	3.6	3	3.5	16%
New Cross Station	13.1	13.6	19.5	43%	4.5	4.9	4.1	-16%	2.9	2.8	4.7	69%
Goldsmiths College, Marquis of Granby	14.5	17	21.1	24%	5.2	5.5	5.1	-8%	2.8	3.1	4.2	35%
New Cross Gate Station	16.8	21.3	24.3	14%	5.7	4.5	8.2	81%	3	4.7	3.0	-37%
New Cross Gate Bus Garage	26.1	28.6	25.1	-12%	14.1	15	10.7	-29%	1.8	1.9	2.4	24%
New Cross Road, Besson Street	12.3	12	16.2	35%	3.1	3.1	3.5	14%	4	3.8	4.6	20%
New Cross Road, Briant Street	10	13.3	11.9	-11%	3.1	2.7	2.5	-7%	3.2	5	4.7	-5%
Pomeroy Street	12.3	15.6	14.8	-5%	3.2	3.6	3.2	-12%	3.8	4.4	4.7	6%
Old Kent Road, Ilderton Road	13.4	16.2	21.7	34%	4.6	4.9	6.1	24%	2.9	3.3	3.6	8%
Commercial Way	14	13.7	18.5	35%	3.2	4.3	3.7	-13%	4.3	3.2	5.0	55%
Peckham Park Road	16.5	23.3	20.3	-13%	5.5	8.6	5.9	-31%	3	2.7	3.4	27%
Malt Street	15.6	25.3	23.0	-9%	4.6	4.3	6.6	53%	3.4	5.9	3.5	-41%
Trafalgar Avenue	12.7	15.3	18.0	17%	3.3	4.3	4.5	5%	3.8	3.6	4.0	11%
Dunton Road	21.8	26.4	26.2	-1%	8	11.8	8.4	-29%	2.7	2.2	3.1	42%
Old Kent Road, East Street	16.1	19.3	21.5	11%	4.9	5.9	4.8	-19%	3.3	3.3	4.5	36%
Bricklayers Arms	12.8	13.2	15.7	19%	2.7	3.1	3.3	5%	4.8	4.2	4.8	14%
Tower Bridge Road	12.2	12.5	17.7	41%	2.5	2.7	3.1	16%	4.8	4.6	5.6	23%
Rodney Place	11.3	9.5	12.8	35%	2.1	1.9	1.7	-13%	5.5	5	7.7	55%
Elephant & Castle, New Kent Road	30.8	33.7	33.1	-2%	19.5	21.7	17.3	-20%	1.6	1.6	1.9	19%
London College of Communication	16.5	25.3	21.3	-16%	7	11.1	7.7	-31%	2.4	2.3	2.8	20%
Imperial War Museum	9.5	11.4	14.3	25%	2.2	3.6	2.8	-22%	4.4	3.2	5.1	59%
Lambeth North Station												

Table I.4: Comparative Dwell Time Statistics by Year, Route and Stop, Route 453 Towards Whitehall

	Average Dwell Time (sec)				Average Number of Boarding/Alighting Passengers				Average Boarding/Alighting Time per Passenger (sec)			
	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %	2003	2008	2015	2008-15 %
Florence Road	-	12	18.6	55%	-	3	8.1	171%	-	4	2.3	-43%
New Cross Station	12.5	10.6	19.2	81%	5	4.2	5.0	19%	2.5	2.6	3.8	48%
Goldsmiths College, Marquis of Granby	14.5	13.2	18.9	43%	6.7	6.7	7.9	19%	2.2	2	2.4	19%
New Cross Gate Station	14.5	18.4	28.4	54%	5.3	12.1	10.9	-10%	2.7	1.5	2.6	73%
New Cross Gate Bus Garage	24.2	22.2	23.3	5%	13	13.6	9.9	-27%	1.9	1.6	2.3	46%
New Cross Road, Besson Street	11.6	13.3	22.4	68%	3.9	6	5.6	-6%	3	2.2	4.0	81%
New Cross Road, Briant Street	10.9	10.2	16.6	63%	3.1	4.5	5.2	15%	3.5	2.2	3.2	46%
Pomeroy Street	12.2	13.4	20.2	51%	6.2	4	5.6	41%	2	3.4	3.6	6%
Old Kent Road, Ilderton Road	13.8	10.6	24.1	128%	6.5	4.2	8.2	96%	2.1	2.6	2.9	13%
Commercial Way	12.6	15.2	19.9	31%	4.4	7.2	4.7	-35%	2.9	2.1	4.3	102%
Peckham Park Road	13.8	18.5	24.0	30%	6.1	9.9	7.9	-21%	2.3	1.9	3.1	61%
Malt Street	13.8	21.1	26.0	23%	4.7	12.5	8.9	-29%	2.9	1.7	2.9	73%
Trafalgar Avenue	12.9	14.7	25.8	76%	4.7	6.1	5.9	-3%	2.8	2.4	4.4	83%
Dunton Road	21.2	26.1	32.8	25%	13.6	17.7	13.0	-27%	1.6	1.5	2.5	68%
Old Kent Road, East Street	15.6	15.7	23.3	48%	7.4	7.2	6.4	-12%	2.1	2.2	3.7	66%
Bricklayers Arms	14	15.7	22.3	42%	3.2	4.8	3.9	-18%	4.4	3.2	5.7	77%
Tower Bridge Road	13	13.8	19.7	43%	4	4.1	3.7	-11%	3.3	3.4	5.4	58%
Rodney Place	10.7	15.6	15.2	-2%	2.9	3.4	1.9	-43%	3.7	4.6	7.9	72%
Elephant & Castle, New Kent Road	23.3	25.4	32.3	27%	20.3	25.7	18.4	-29%	1.1	1	1.8	76%
London College of Communication	18.5	21.7	26.5	22%	11.4	12.8	8.5	-34%	1.6	1.7	3.1	84%
Imperial War Museum	10.6	13	17.2	32%	2.2	3.7	5.5	49%	4.8	3.5	3.1	-11%
Lambeth North Station	14.5	13.1	18.3	39%	3.9	3.7	3.4	-9%	3.7	3.5	5.5	56%
Lower Marsh	12.9	10.6	23.5	122%	4.7	3	3.3	8%	2.8	3.5	7.2	107%
Waterloo, County Hall	16.7	19.6	27.4	40%	8.6	15.4	10.2	-34%	1.9	1.3	2.7	106%
Parliament Square	10	17.5	22.8	30%	2.2	7.5	4.7	-38%	4.6	2.4	4.9	103%

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Horse Guards Parade	15.7	13.4	14.3	7%	4.3	4	1.9	-52%	3.6	3.4	7.4	117%
Trafalgar Square	16.4	19.6	21.0	7%	5.3	12.3	7.8	-36%	3.1	1.6	2.7	67%
Regent Street, Jermyn Street	14.7	13.2	22.6	72%	7.8	6.7	7.2	7%	1.9	2	3.2	58%
Piccadilly Circus	21.5	11.9	22.2	86%	6.2	5.4	3.7	-32%	3.5	2.2	6.0	175%
Conduit Street	12.9	15.5	15.3	-1%	6.3	4.8	3.9	-19%	2	3.2	4.0	24%
Margaret Street, Oxford Circus	18.1	37.8	25.5	-32%	12.8	14.3	9.5	-33%	1.4	2.6	2.7	3%
Portland Place	10.4	12.7	15.8	25%	3.9	5	2.9	-42%	2.7	2.5	5.5	119%
Great Portland Street Station	-	-	14.4	-	-	-	2.5	-	-	-	5.8	-
Regent's Park Station	10.3	12.1	13.2	9%	3	5.5	1.1	-79%	3.4	2.2	11.5	424%
Harley Street	12.1	11.5	13.1	14%	2.8	1.3	2.2	69%	4.4	8.9	6.0	-33%
Baker Street Station	11.2	16.8	16.0	-5%	2.8	7.4	3.6	-51%	4	2.3	4.4	92%
Baker Street , Gloucester Place	7.3	16.9	20.5	21%	1	7	1.8	-75%	7.3	2.4	11.5	380%
Marylebone, Great Central Street												

Control Sheet

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SDG Project/Proposal No.

22780601

Issue history

Issue No.	Date	Details
1	2015.03.25	Draft for Comment
2	2015.04.13	Final Draft
3	2015.06.02	Final

Review

Originator

[REDACTED]

Other Contributors

[REDACTED], [REDACTED]

Reviewed by

[REDACTED], [REDACTED]

Distribution

Client

Steer Davies Gleave



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